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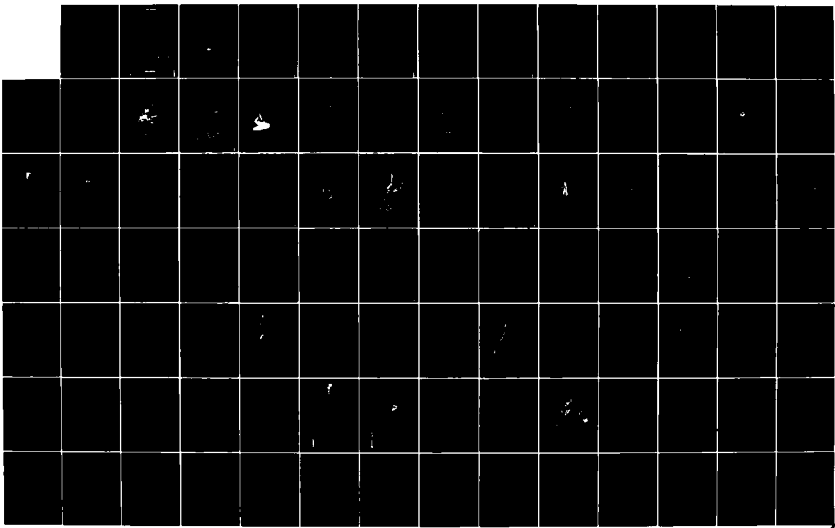

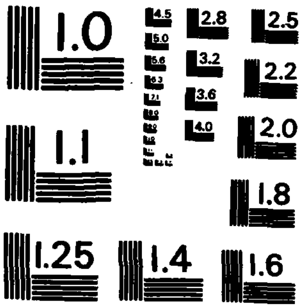


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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EDGECLIFF, N.S.W.

# RANRL TECHNICAL MEMORANDUM (EXTERNAL) No. 5/82

# COMPARISONS BETWEEN PATTERNS OF SEA-SURFACE TEMPERATURE AND SUB-SURFACE PARAMETERS IN THE WESTERN TASMAN SEA (U)

BY
P. J. MULHEARN
&
L.J. HAMILTON



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RAN RESEARCH LABORATORY



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# COMPARISONS BETWEEN PATTERNS OF SEA-SURFACE TEMPERATURE AND SUB-SURFACE PARAMETERS IN THE WESTERN TASMAN SEA (U)

P.J. MULHEARN

and

L.J. HAMILTON



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## ABSTRACT

Comparisons are presented between patterns of sea-surface temperature, temperature at 250m, mixed-layer depth and dynamic height for the western Tasman Sea. Data are from ship cruises and aerial surveys. It is shown by comparing deep current structures, shown by the temperature fields at 250 metres and/or dynamic heights, with surface temperature patterns that on many occasions the latter revealed the East Australian Current flowing down the coastline, turning eastwards between 30° and 32°S and, sometimes, turning back to the north. Also on most occasions in winter and spring, and sometimes in summer-autumn, warm-core eddies were apparent in surface temperature patterns. In general, surface mixed-layers are deeper above anticyclonic features and shallower above cyclonic features.

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## 1. INTRODUCTION

In real-time ocean-analysis, data on sea-surface temperatures (SST) are far more readily available than values of sub-surface parameters such as the temperature field at 250 metres or dynamic heights from which ocean and current structure can be determined by visual examination of iso-contours. It is therefore worthwhile considering the extent to which SST's can reveal the positions of major fronts and eddies, and variations in surface mixed-layer depth (MLD). In the western Tasman the major mesoscale features are revealed by the distribution of the temperature isotherms at 250m (T250) as well as by Dynamic Height variations.

In this note thirty four case-studies are presented to show comparisons between SST and either T250 or dynamic height to determine if features shown in the T250 and/or dynamic height patterns are also seen in the SST pattern. Eighteen of these cases also show how the MLD pattern varies with that for T250 (or dynamic height), and for nine cases the close correspondence between T250 and dynamic height is demonstrated.

The thirty four cases presented also demonstrate the types of mesoscale variability to be expected in the western Tasman. For a few cases temperature sections through areas of interest are included to give an indication of vertical structure.

## 2. THE DATA

Data were obtained from the papers of Hamon (1965), Boland and Hamon (1970), Nilsson and others (1977), Nilsson and Cresswell (1981), Andrews and others (1980), Lawrence (1980), Boland and Church (1981), the bathythermograph data banks of C.S.I.R.O., Cronulla, and of the Australian Oceanographic Data Centre (AODC). For dynamic height values limited use was made of C.S.I.R.O.'s Nansen cast data bank.

The data is presented as sets of diagrams of sea-surface temperature, mixed-layer depth, temperature at 250 metres, and dynamic height for each survey, or sea-surface temperature and temperature at 250 metres. See Figs 1-99 and List of Figures.

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## 3. MAIN FEATURES OF WESTERN TASMAN SEA OCEANOGRAPHY

Typically the East Australian Current (EAC) flows down the eastern Australian coast, separates from it between Smoky Cape and Sugarloaf Point (i.e. between $31^{\circ}$ and $32^{\circ}$ S) and turns eastwards. It then either turns back towards the north forming a large meander, or simply continues eastwards to the vicinity of Lord Howe Is.

When a meander forms it sometimes pinches off to form a detached warm-core eddy between approximately $34^{\circ}$S and $38^{\circ}$S. More than one eddy may be present at one time.

## 4. COMPARISONS BETWEEN SST AND $T_{250}$ (OR DYNAMIC HEIGHT) PATTERNS

Infra-red (i.r) images of the sea-surface from satellites often reveal filaments of warm surface water being advected southward along the East Australian Current, and around both cyclonic and anti-cyclonic features which, in the southern hemisphere, have clockwise and anticlockwise circulation respectively. It is clear that very detailed ship surveys of sea-surface temperature would be required to delineate these thin features and cruises of this nature have not been undertaken. Ship-surveys can also take one to two weeks to cover an area so that the data obtained are not synoptic. Patterns of oceanographic variables may shift significantly in this time period. For these reasons it is suspected that satellite i.r. images will reveal deeper oceanographic features more clearly than the SST data from ship cruises which are discussed herein.

Principal features observed in SST patterns which relate to deeper current structure are:

(i) a front with warmer water to the east, at the western edge of the East Australian Current as it flows down the coast to about $30^{\circ}$ to $32\frac{1}{2}^{\circ}$ S. A tongue of warm surface water, parallel to the current may also be present, which at times is fairly broad. (See Figs. 1, 9, 15)

(ii) A surface front defining the EAC as it swings eastwards with colder water to the south. Occasionally a warm tongue parallel to the current is also present. (See Figs. 7, 9, 17, 19, 24, 28 for example)

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(iii) A surface front, with warmer water to the west, on those occasions when the EAC swings back towards the north. (See Figs. 9, 17, 46)

(iv) Surface fronts around warm-core eddies. These are sometimes not apparent on the northern side of eddies. Warm surface tongues may also be present around the eddy edge. (See Figs. 7, 42, 62)

Table I shows the occasions on which these features were observed on SST patterns on individual cruises compared with the occasions they were seen to be present from deep current structure in $T_{250}$ and/or dynamic height patterns. On the 22 surveys covering the EAC flowing southward along the coast the current was evident on 13 (59%) occasions. The surface front may be missed on ship-surveys if it occurs too close inshore. On the 23 surveys covering the eastward turning of the EAC it showed up in SST patterns on 19 (83%) occasions, while SST patterns revealed the EAC returning to the north on 7 (70%) of the 10 occasions on which this feature was found. No seasonal dependence was discernable in the correspondence between SST patterns and the above features of the EAC.

In contrast clear seasonal dependence was found in the extent to which SST patterns showed up warm-core eddy positions. Of 22 surveys covering eddies, SST patterns revealed them on 13 (59%) of occasions.....

......... Table II summarises the percentage of cruises in which various features were visible in SST patterns and Table III shows the seasonal dependence of the correspondence between SST patterns and deeper structure in eddies. Note that from June to Nov. SST's showed up the eddies on 75% of occasions. Seasonal variations in temperature in warm-core eddies are discussed in Mulhearn (1982).

## 5. COMPARISONS BETWEEN MLD AND $T_{250}$ (OR DYNAMIC HEIGHT) PATTERNS

Mixed-layer depth patterns are shown in Figs. 2, 12, 20, 27, 29, 31, 33, 36, 40, 43, 47, 59, 83, 90, 96. MLD is defined as depth at which temperature deviates from its surface value by 0.2°C. Some of the patterns are quite complex and details of the variations do not always bear a clear relation to the deeper structure. This could be due either to internal wave activity or variations in mixed-layer deepening caused by

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atmospheric effects. Some conclusions can however be drawn. The surface mixed-layer is in general deeper over anticyclonic features, such as warm-core eddies and southward bulges in the EAC, and shallower over cyclonic (colder) features. MLD increases as the centre of an anticyclonic feature is approached. Shallowing of mixed-layers at fronts relative to values outside an anticyclonic feature is often not apparent, though some complex variations must occur in the frontal region itself when there are considerable horizontal temperature variations. Variations of MLD in warm-core eddies are discussed in Mulhearn (1982).

## 6. COMPARISONS BETWEEN T250 AND DYNAMIC HEIGHT PATTERNS

As has been discussed in Nilsson and Cresswell (1981) there is a strong correlation between T250 and the Dynamic Height of the sea-surface relative to 1300m. Both Dynamic Height and T250 patterns are shown for cruises in the following months of 1978 - March, May-June, June, August, September, late September and December, and for cruises in February 1979 and April 1980. The correspondence is probably closer than observed in some cases because of the limited number of nansen-casts available. Note: Some of the dynamic height patterns were drawn from dynamic heights calculated using T250 values in a regression relationship, and Nansen station data, so not all T250 and dynamic height patterns given are independent. Dynamic height patterns formed from T250's are shown in Figs. 13, 16, 57, 66 and 69.

## ACKNOWLEDGEMENTS

Thanks are due to Mr. R. Edwards of C.S.I.R.O. and Mr. B. Searle of AODC for their assistance in providing data from their respective data banks and to Lt. Cdr. John Bracher, RAN and C.P.O. C. Fullwood, R.A.N., for helping in plotting up some of the data.

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8. Nilsson, C.S. and Cresswell, G.R. (1981). Prog. Oceanogr. 9, 133-183.


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## LIST OF FIGURES



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| | | | | | | |
|---|---|---|---|---|---|---|
| SP7/79 Second Survey | 78 | | 79 | | May 23 - June 6 | 1979 |
| SP8/79 | 80 | | 81 | | July 5 - 18 | 1979 |
| SP9/79 | 82 | 83 | 84 | | Aug 17 - 31 | 1979 |
| SP10/79 | 85 | | 86 | | Sep 20 - Oct 3 | 1979 |
| SP11/79 | 87 | | 88 | | Oct 17 - 30 | 1979 |
| SP3/80 | 89 | 90 | 91 | | Feb 5 - 12 | 1980 |
| SP6/80 | 92 | | 93 | 94 | Apr 11 - 30 | 1980 |
| YARRA SP3/80 | 95 | 96 | 97 | | July 25 - 31 | 1980 |
| SO4/81 | 98 | | 99 | | Sep 25 - Oct 18 | 1981 |

## SYMBOLS USED:

AXBT - Aerial Survey

DM - HMAS Diamantina

G - HMAS Gascoyne

K - HMAS Kimbla

SP - Sprightly (CSIRO) SO - FRV Soela

SST - Sea Surface Temperature (°C)

MLD - Surface Mixed Layer Depth (defined for water within 0.2°C of surface temp)

$T_{250}$ - Temperature field at 250 metres depth

DYN. HT - Dynamic Height (dbar wrt 1300 metres)

CROSS SECTION - Cross-section of isotherms (°C) with depth (m)

## TABLE I

## S.S.T. vs $T^{250}$ (OR DYNAMIC HEIGHT)

OCCASIONS WHEN A FEATURE WAS DISCERNABLE IN SST PATTERNS

| Feature / Date | Fig. Nos. | EAC down coast | EAC turning east | Eastern edge of EAC meander | Eddy | Eddy except North Side |
|---|---|---|---|---|---|---|
| Nov-Dec 60 | 1-4 | yes & W.T. | no | | - | yes |
| Sep-Oct 62 | 5 & 6 | no | vaguely | vaguely | N.P. | |
| Sep 63 | 7 & 8 | | yes | | yes | - |
| Nov 63 | 9 & 10 | yes | yes | yes | N.P. | |
| Jan-Feb 64 | 11-14 | very weakly | very weakly | vague | no | - |
| Mar 64 | 15 & 16 | yes | diffuse | | no | - |
| Aug 64 | 17 & 18 | only W.T. up N. | yes | yes | | |
| Sep 64 | 19-23 | only broad W.T. up N. | yes | yes | | |
| Nov 65 | 24 & 25 | no | yes | | no | - |
| Feb-Mar 77 | 26-27a | yes & W.T. | yes | | no | - |
| Mar 77 | 28-29a | yes | yes | | no | - |
| late Mar 77 | 30-31a | | | | - | yes |
| Feb 78 | 32-34 | yes & W.T.* | yes | | yes | - |
| Mar 78 | 35-38 | no | very weakly | | | |
| Apr 78 | 39-41 | W.T. only | yes | | no | - |
| May-June 78 | 42-45 | | | | - | yes & W.T. on N. |
| June 78 | 46-49 | no | yes | yes | | |
| Jul-Aug 78 | 50 & 51 | | yes | | | |
| Aug 78 | 52-54 | W.T. up N. only | no | no | no | - |
| Sep 78 | 55-57 | no | yes | yes | - | yes |
| late Sep 78 | 58-61 | | | | no | |
| early Dec 78 | 62 & 63 | | | | - | yes |

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TABLE I CONT.

OCCASIONS WHEN A FEATURE WAS DISCERNABLE IN SST PATTERNS

| Feature / Date | Fig. Nos. | EAC down coast | EAC turning east | Eastern edge of EAC meander | Eddy | Eddy except North Side |
|---|---|---|---|---|---|---|
| Dec 78 | 64-66 | no | yes | no | | |
| Feb 79 | 67-69 | no | yes | no | | |
| Mar 79 | 70 & 71 | no | yes | | | |
| May 79 | 72-75 | weak & W.T. | | | | |
| May-June 79 | 76-79 | | | | - | yes |
| July 79 | 80 & 81 | no | no | | yes | - |
| Aug 79 | 82-84 | | | | - | yes |
| Sep-Oct 79 | 85 & 86 | | | | yes | - |
| Oct 79 | 87 & 88 | | | | - | yes |
| Feb 80 | 89-91 | | | | no | - |
| Apr 80 | 92-94 | weak | | | | |
| July 80 | 95-97 | | yes | | yes (2 present) | - |

* EAC further offshore than normal in this case.

Notes: W.T. ≡ warm tongue,
N. ≡ North.

A blank signifies that a feature was not surveyed.

N.P. ≡ feature not present.

\- signifies eddy observations are in alternative criterion.

TABLE II

PERCENTAGE OF OCCASIONS ON WHICH A DISCERNABLE FEATURE DETECTED IN SST PATTERNS

| Feature | EAC down coast | EAC turning east | east edge of meander | eddy |
|---|---|---|---|---|
| % | 59 | 83 | 70 | 59 |

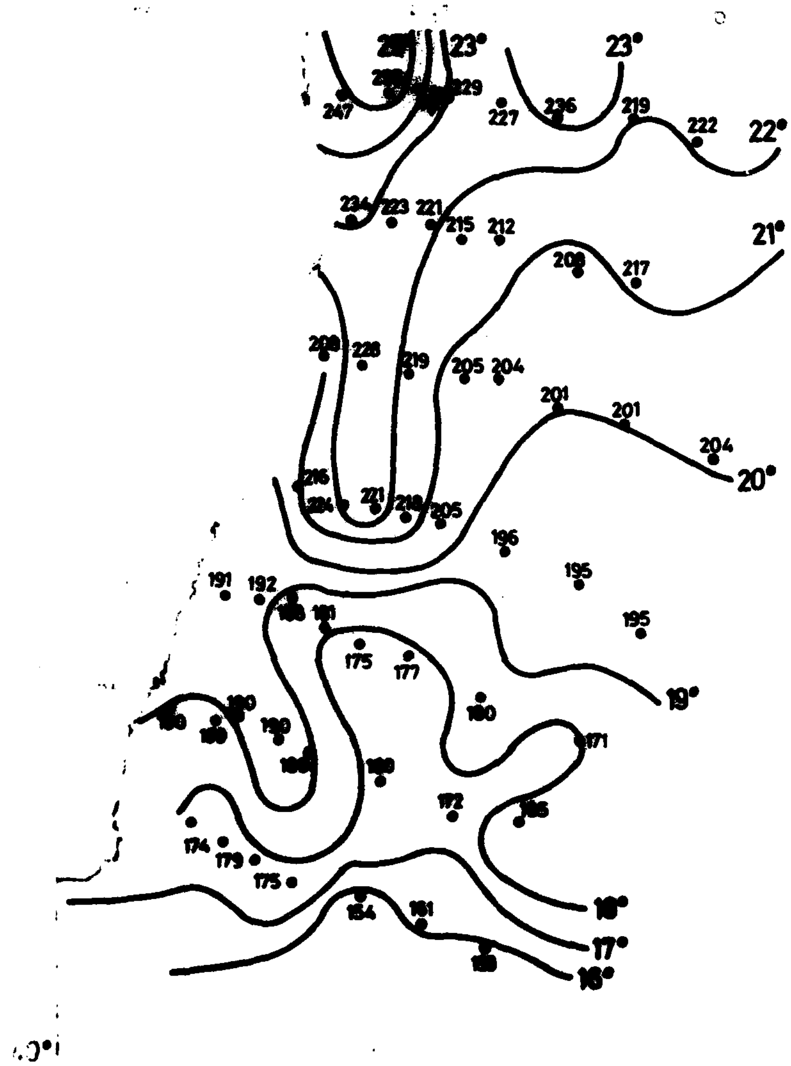


Fig. 1. SST. G 3/60. Nov. - Dec. 1960.

TABLE III

SEASONAL VARIATION IN DISCERNABILITY OF AN EDDY IN SST PATTERN

| Months | Dec-Feb | Mar-May | June-Aug | Sept-Nov |
|---|---|---|---|---|
| % of occasions on which discernable: | 25 | 30 | 80 | 70 |
| No. of cruises: | 4 | 7 | 5 | 7 |

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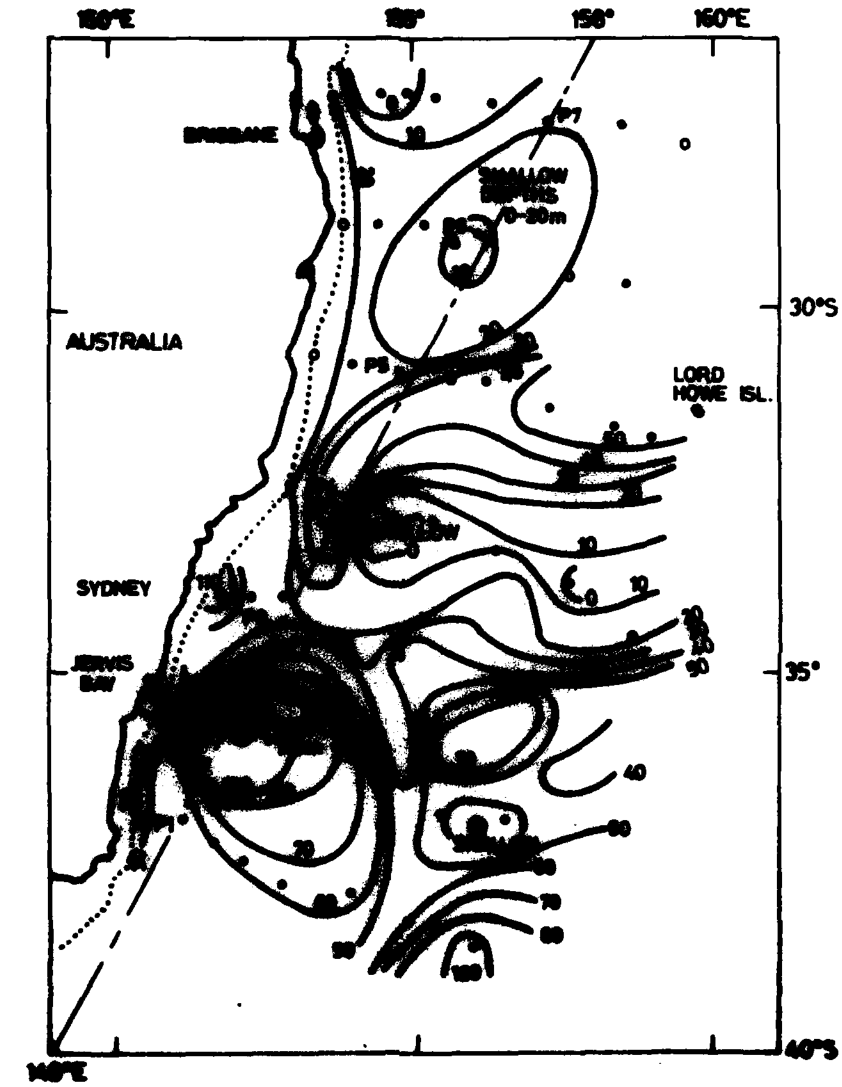


Fig. 2 Surface mixed layer depth for cruise G3/80 (Nov. 8 – Dec. 4, 1980).

A CROSS-SECTION OF ISOTHERMS VERSES DEPTH WAS CONSTRUCTED ALONG THE DASHED LINE, USING BATHYTHERMOGRAPH RESULTS AT POINTS P1 TO P7.

THE SURFACE MIXED LAYER DEPTH IS DEFINED BY WATERS WITHIN 0·2°C OF THE SURFACE TEMPERATURE.

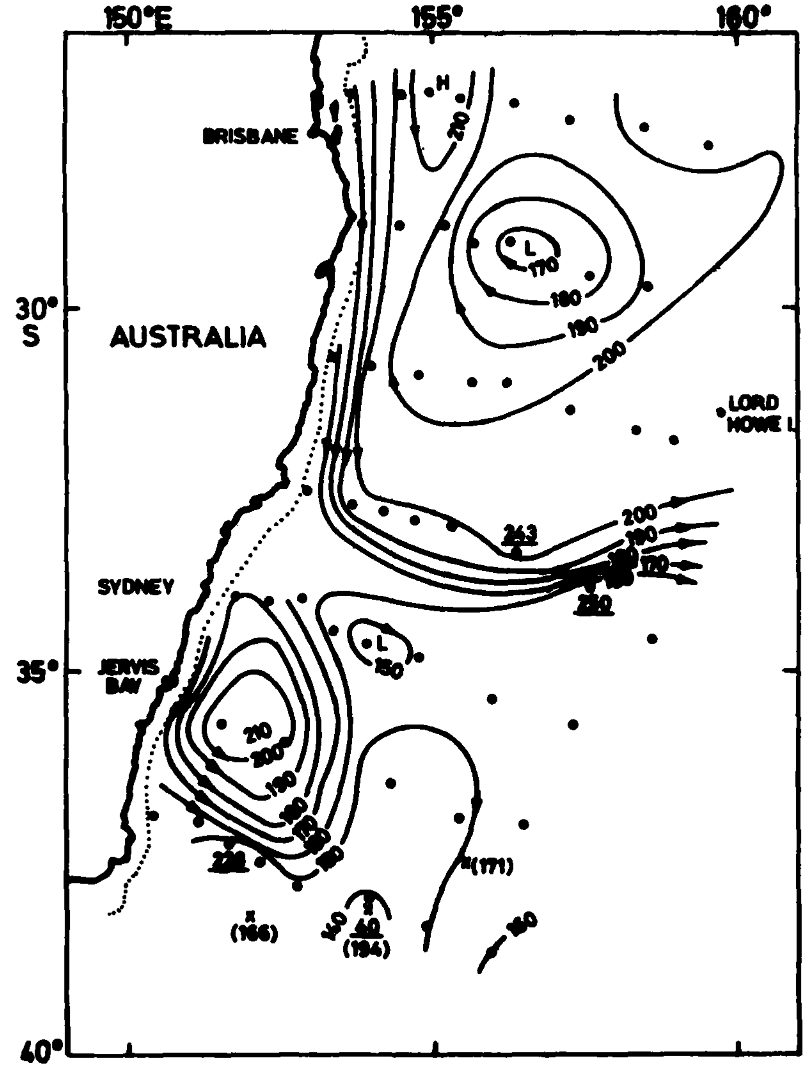


Fig.3. Surface dynamic topography, relative to 1300 decibars, for Cruise G3/60 (Nov. 8 – Dec. 4, 1960).
• Stations with sampling to at least 1300 m.
• Stations with sampling to less than 1300 m.
× Three stations on Cruise G1/61, with dynamic heights in brackets.

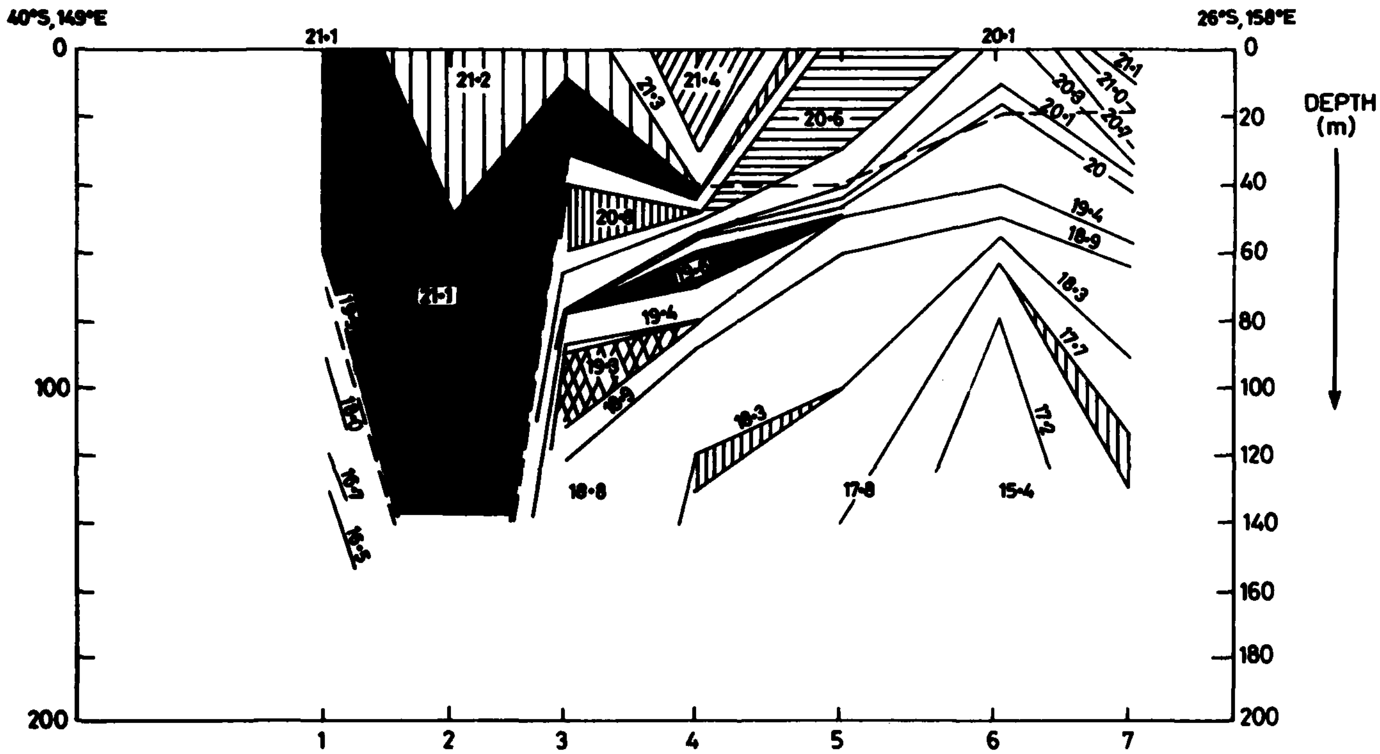


Fig. 4. Cross-section of temperature isotherms (°C) verses depth (m) for cruise G3/60 (Nov. 8 — Dec. 4, 1960).

AN EDDY IS CENTRED AROUND REFERENCE POINT 2.
DASHED LINE SHOWS SURFACE MIXED LAYER DEPTH (WATERS WITHIN 0·2°C OF SURFACE TEMPERATURE).

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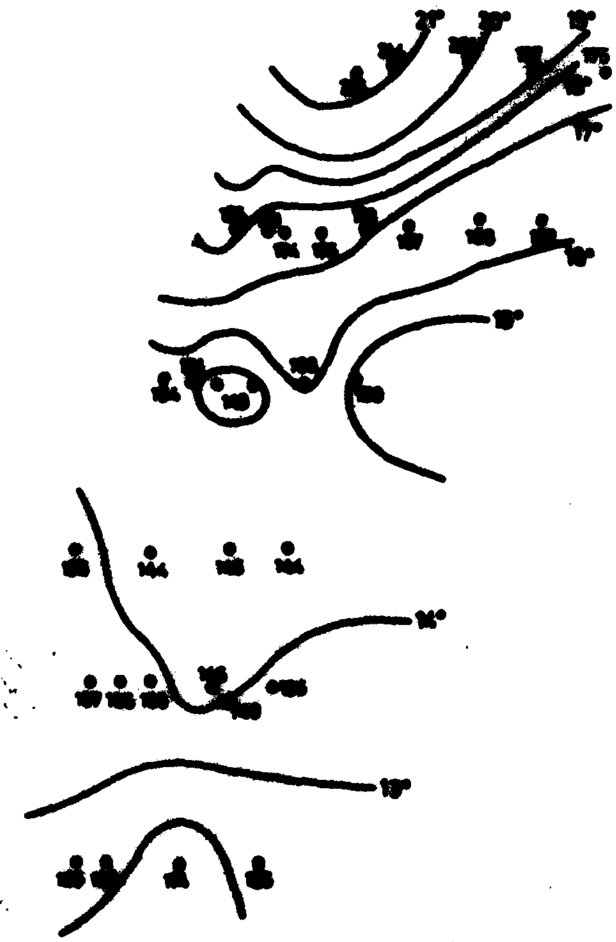

Fig.5.SST. 06/82. Sept /Oct. 1982.

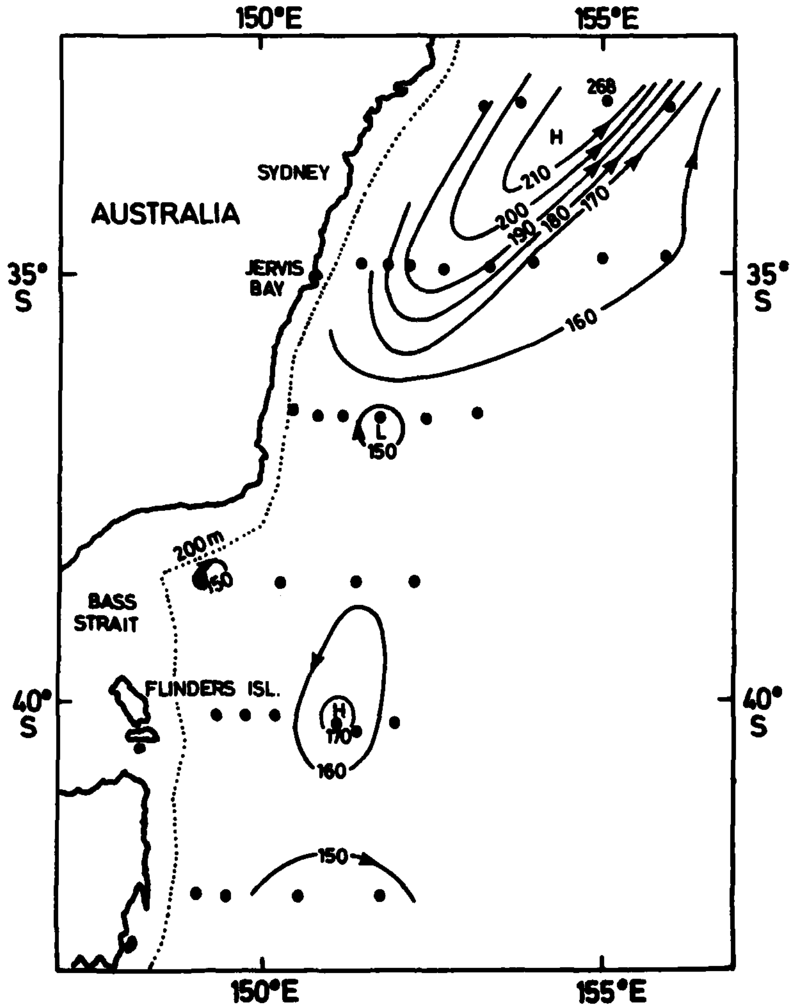


Fig. 6. Surface dynamic topography, relative to 1300 decibars, for Cruise G5/62 (Sept. 30 – Oct. 10, 1962)

OCT.80

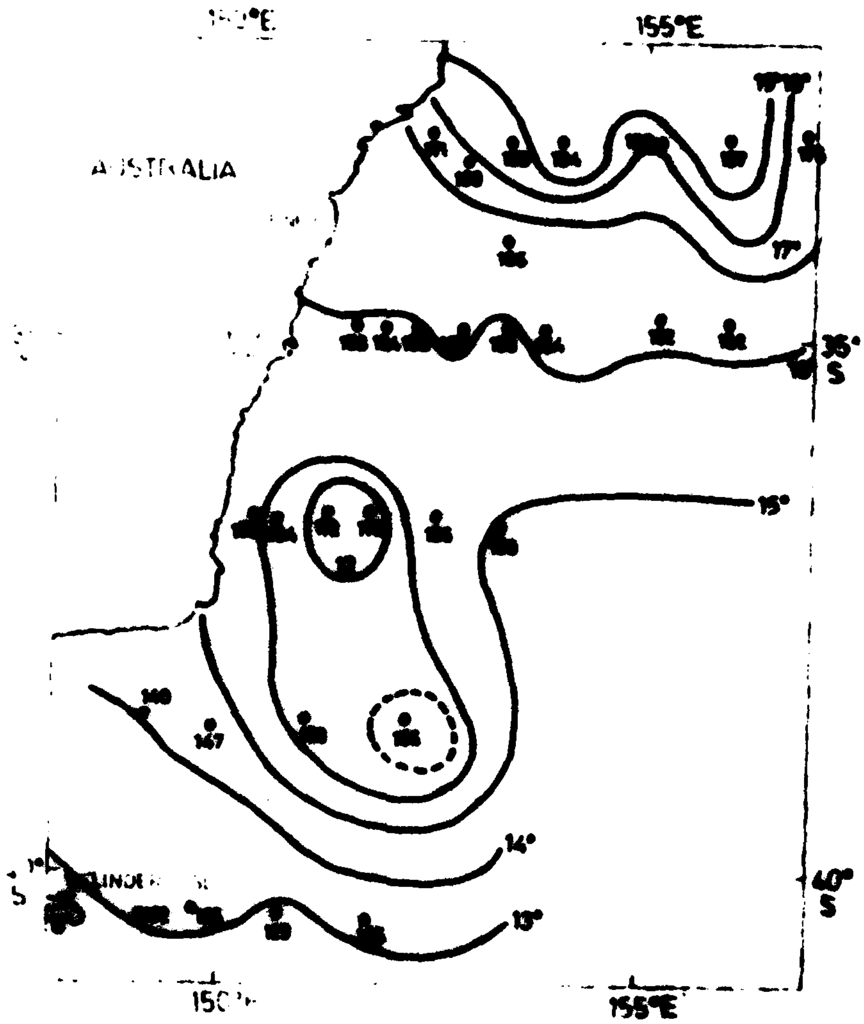

Fig. 7. SST. 04/63. Sept. 1963.

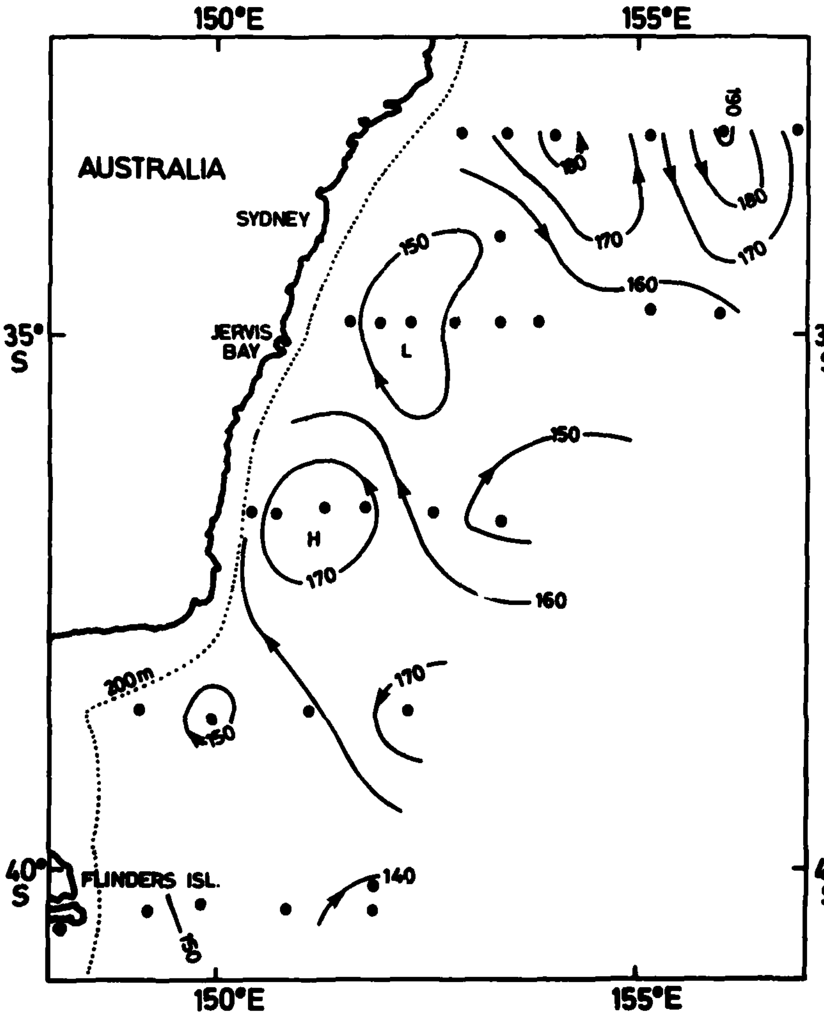


Fig.8. Surface dynamic topography, relative to 1300 decibars, for Cruise G4/63 (September 9-18, 1963)

OCT.80

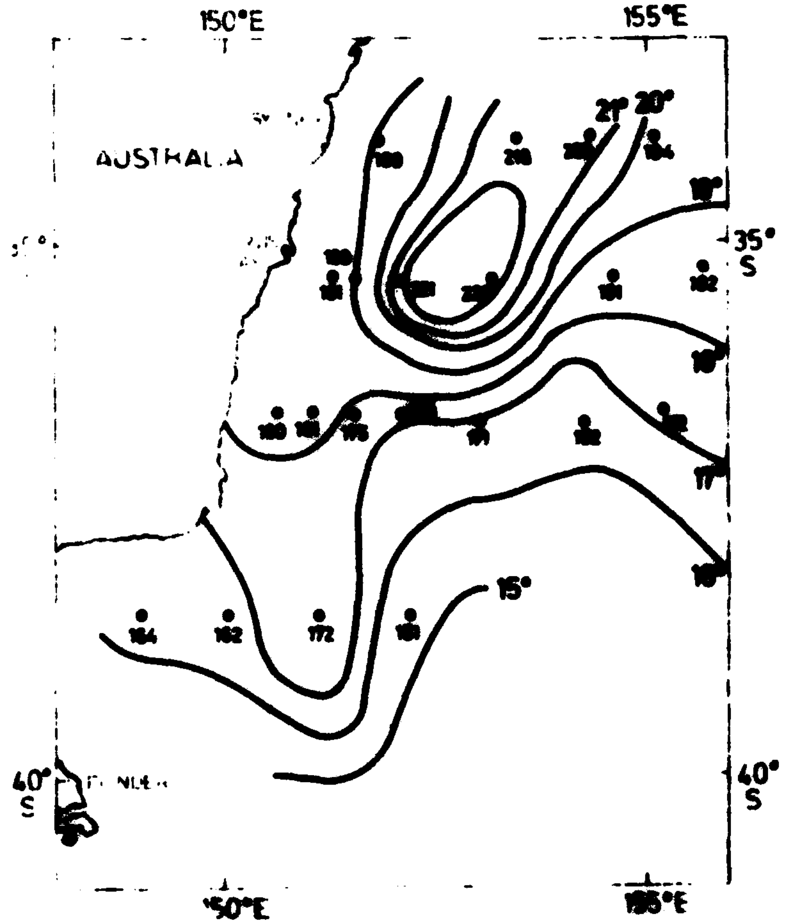


**Fig. 9. SST. G5/63. Nov. 1963.**

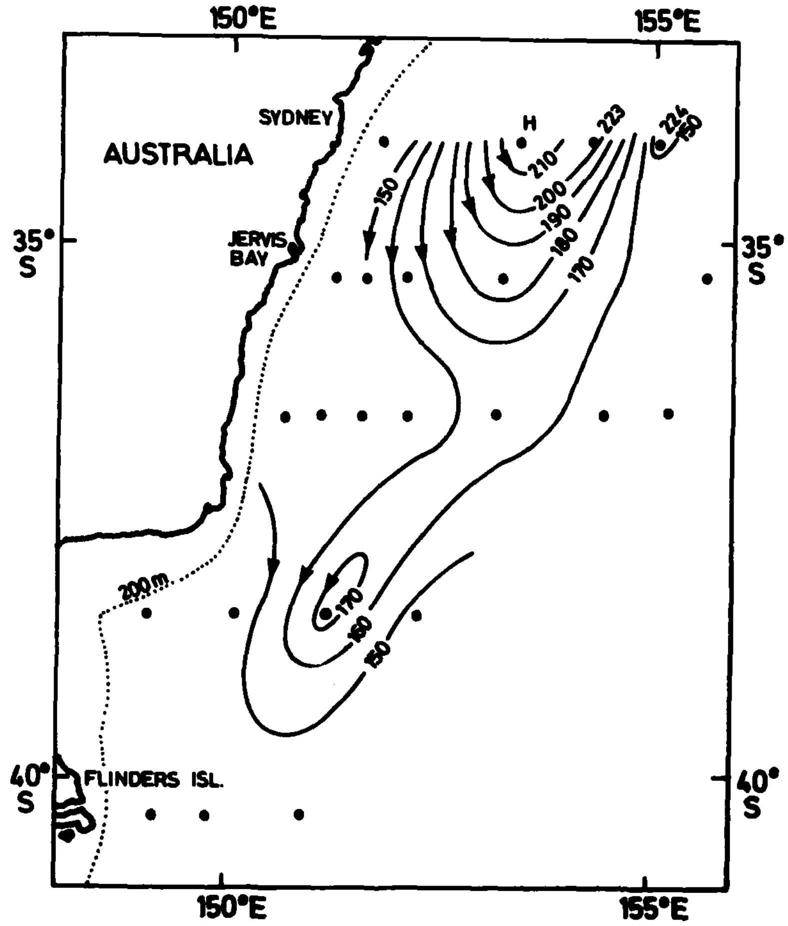


Fig.10. Surface dynamic topography, relative to 1300 decibars, for Cruise G5/63 (November 7-15, 1963)

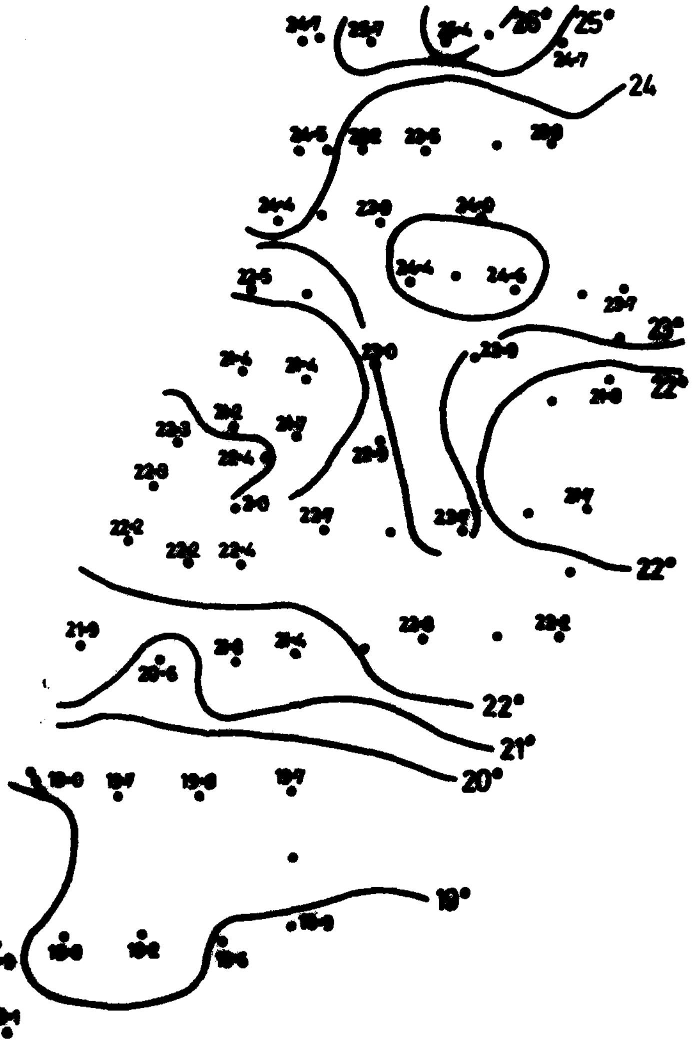


Fig. 11. SST. 01/64. Jan. - Feb. 1964.

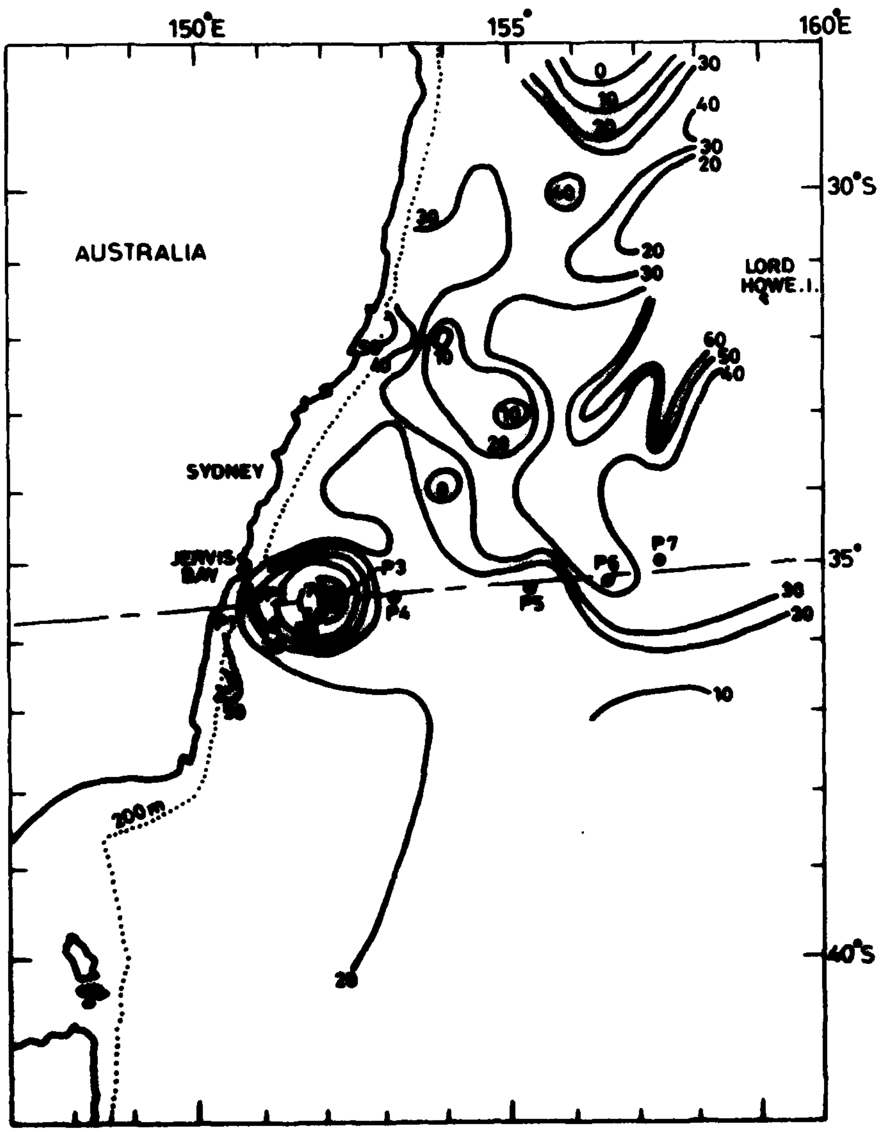


Fig.12. Surface mixed layer depth for cruise G1/64 (Jan. 13 - Feb. 6, 1964).

A CROSS-SECTION OF ISOTHERMS VERSUS DEPTH WAS CONSTRUCTED ALONG THE DASHED LINE, USING BATHYTHERMOGRAPH RESULTS AT POINTS P1 TO P7.

THE SURFACE MIXED LAYER DEPTH IS DEFINED BY WATERS WITHIN 0·2°C OF THE SURFACE TEMPERATURE.

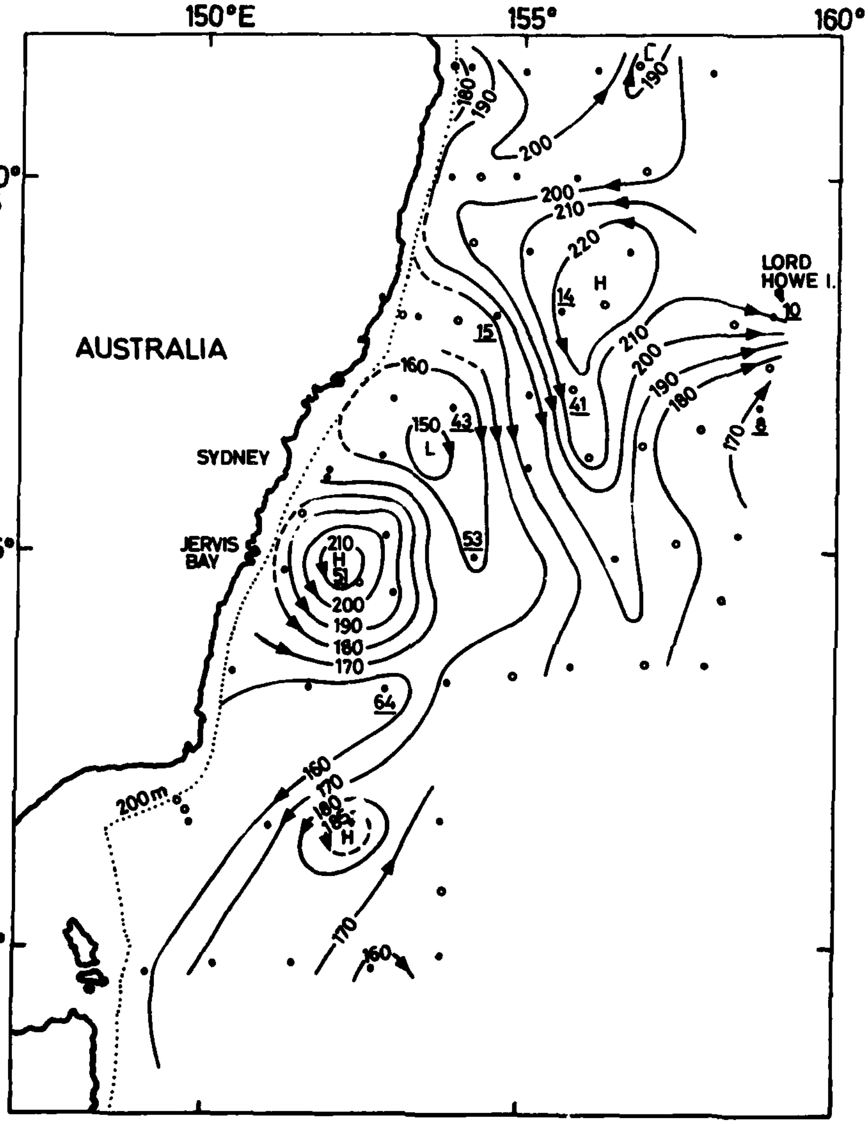


Fig.13. Surface dynamic topography, relative to 1300 decibars, for Cruise G1/64 ( Jan. 13 - Feb. 6, 1964 ).
• Stations with sampling to at least 1300 m.
• Bathythermograph stations to 285 m.

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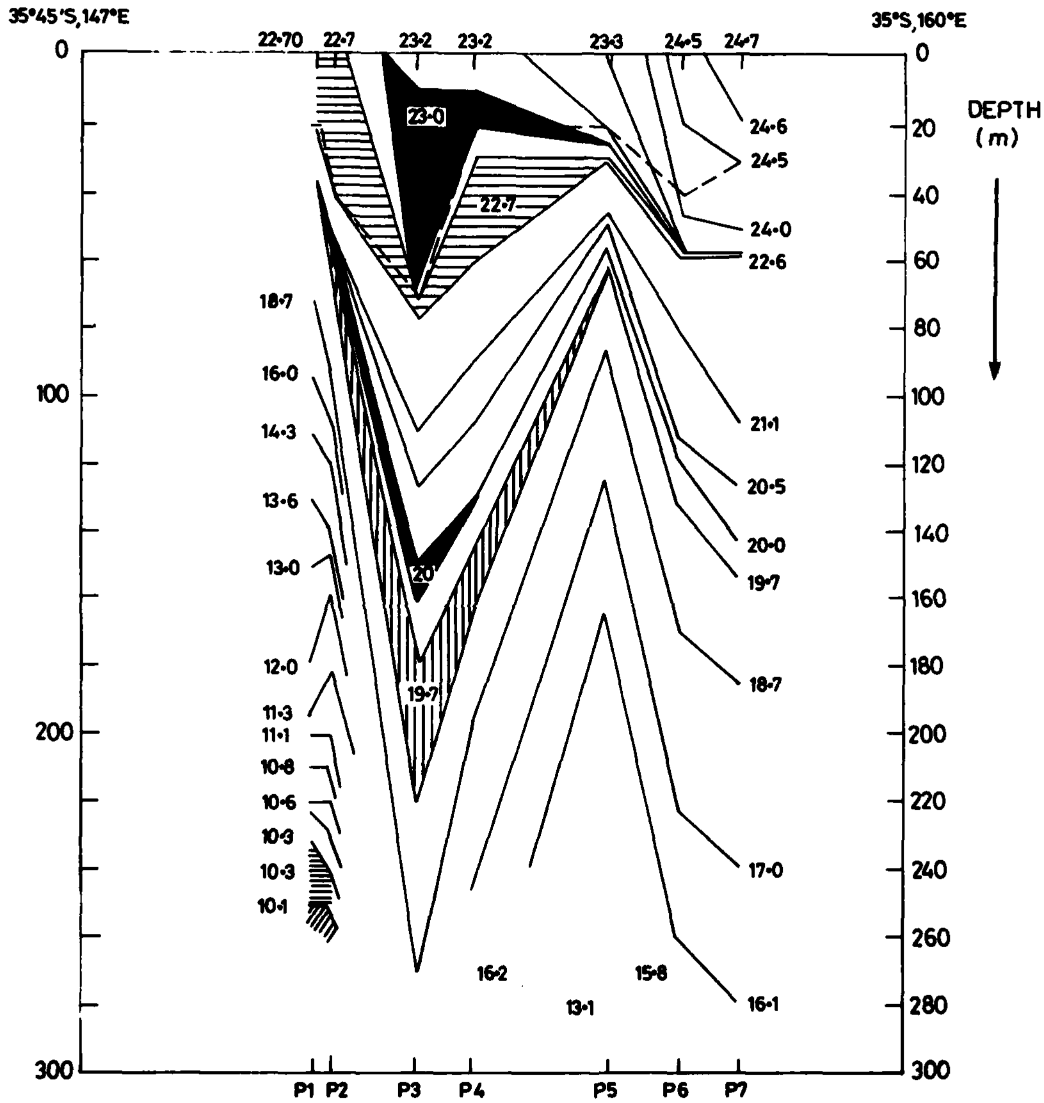


**Fig.14. Cross-section of isotherms verses depth for cruise G1/64 (Jan.13 – Feb. 6, 1964).**

DASHED LINE SHOWS SURFACE MIXED LAYER DEPTH (WATERS WITHIN 0·2°C OF SURFACE TEMPERATURE).

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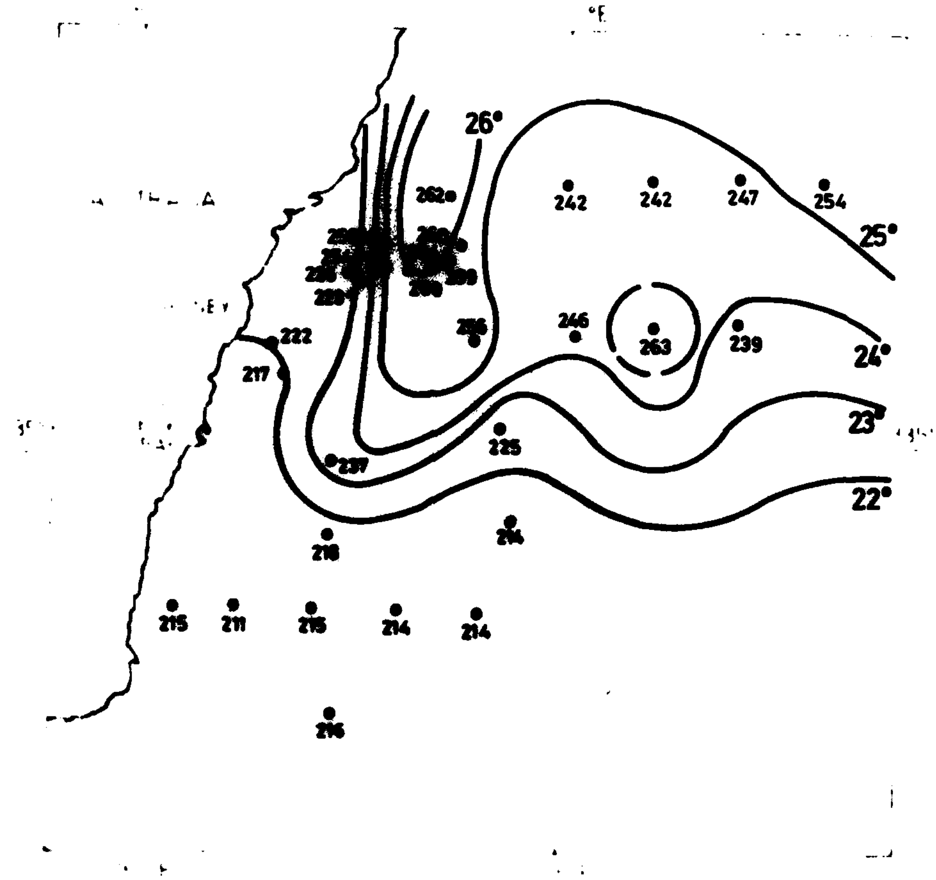


Fig. 15. SST. G3/64. Mar. 1964.

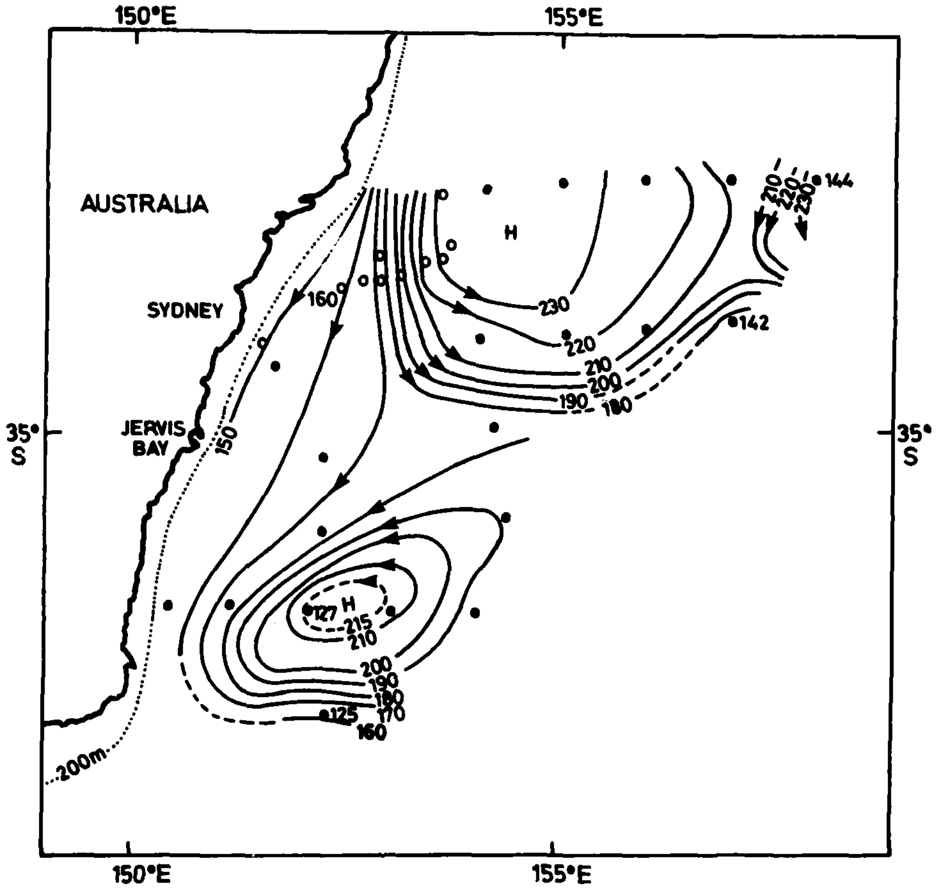


Fig.16. Surface dynamic topography, relative to 1300 decibars, for Cruise G3/64 March 18-25, (1964)

• Stations with sampling to at least 1300 m.

∘ Bathythermograph stations to 285 m.

OCT.80

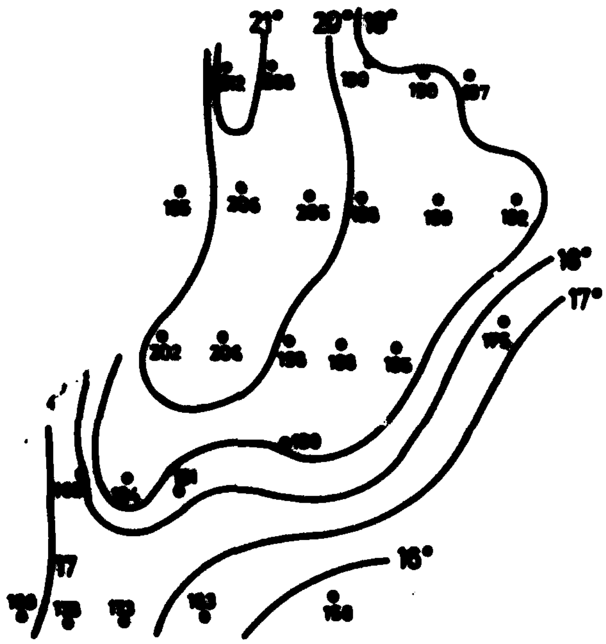


Fig. 17. SST. 4/64. Aug. 1964.

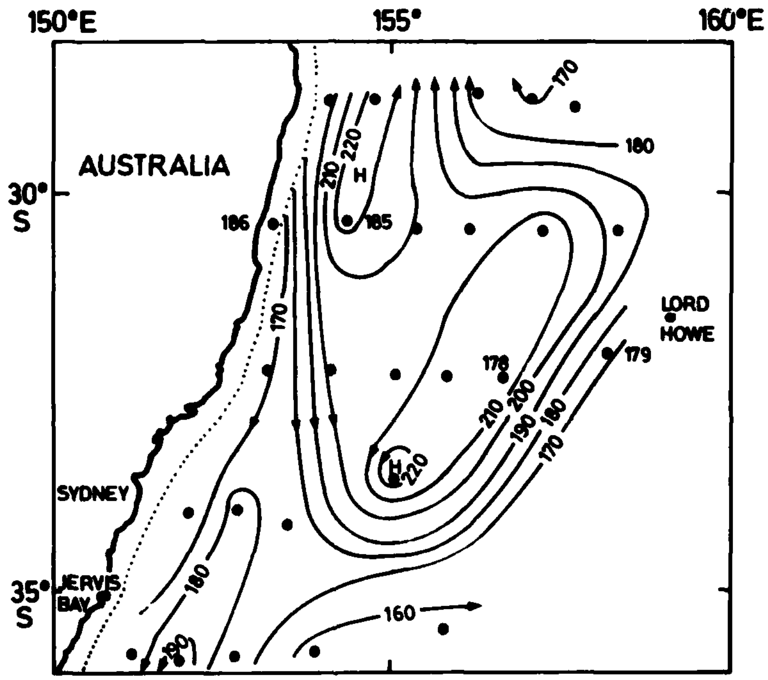


Fig.18 Surface dynamic topography, relative to 1300 decibars, for Cruise G4/64. (Aug. 3–13, 1964)

NOV. 80

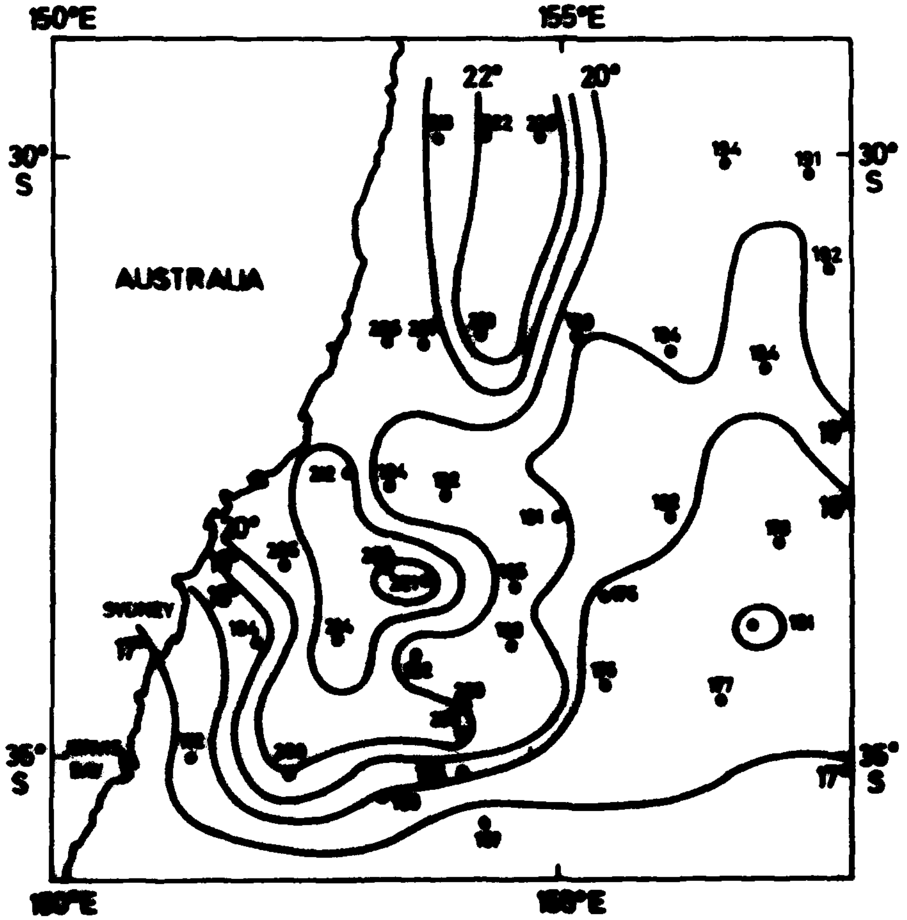


Fig. 10. SST. G6/64. Sept. 1964.

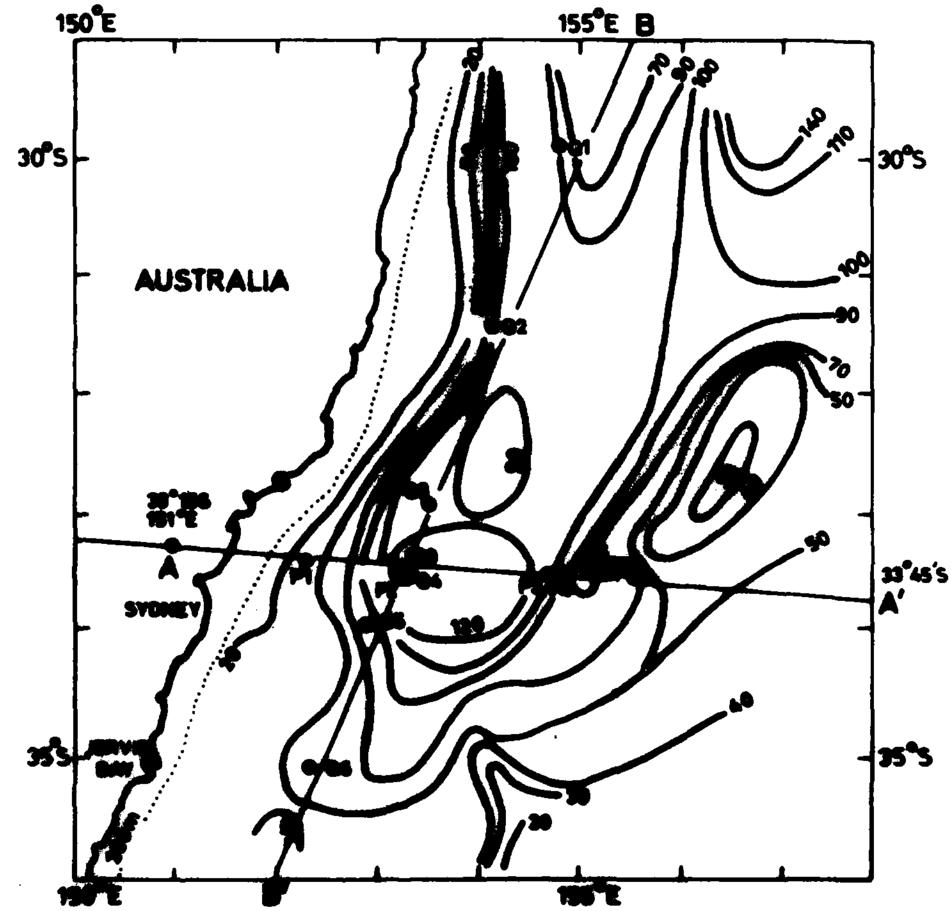


Fig.20. Surface mixed layer depth for cruise G6/64 (Sept. 16-27, 1964).

CROSS-SECTIONS OF ISOTHERMS VERSUS DEPTH WERE CONSTRUCTED ALONG AA' AND BB'.

THE MIXED LAYER DEPTH IS DEFINED BY WATERS WITHIN 0·2°C OF THE SURFACE TEMPERATURE.

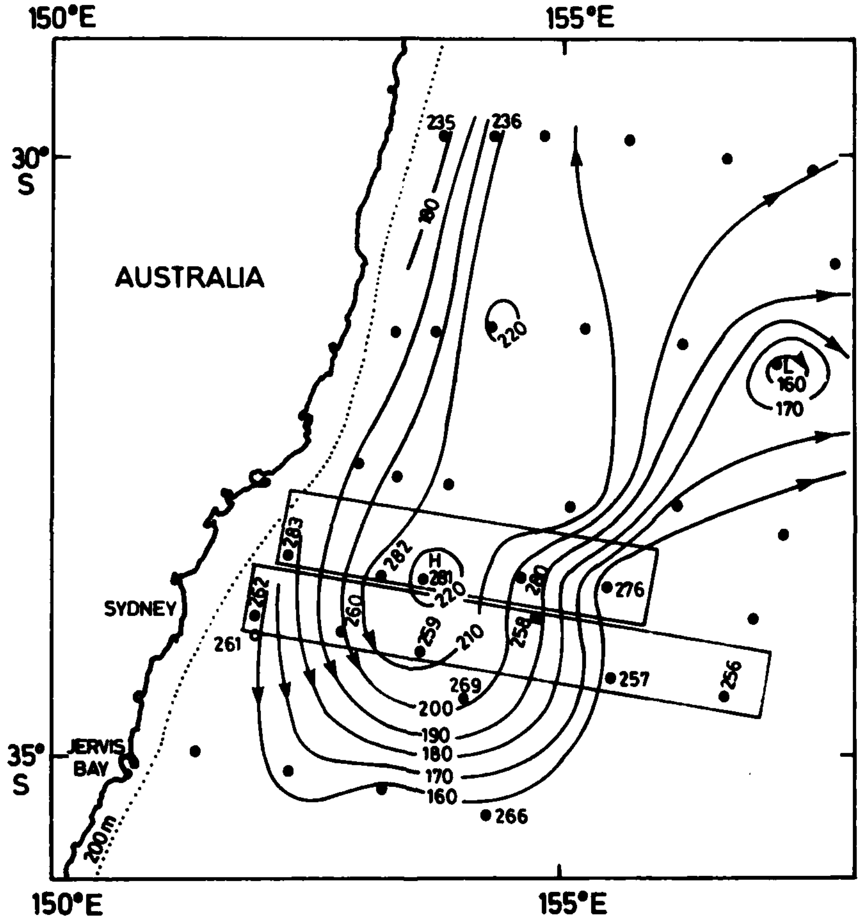


Fig.21. Surface dynamic topography, relative to 1300 decibars, for Cruise G 6/64 (Sept. 16–27, 1964)

OCT.80

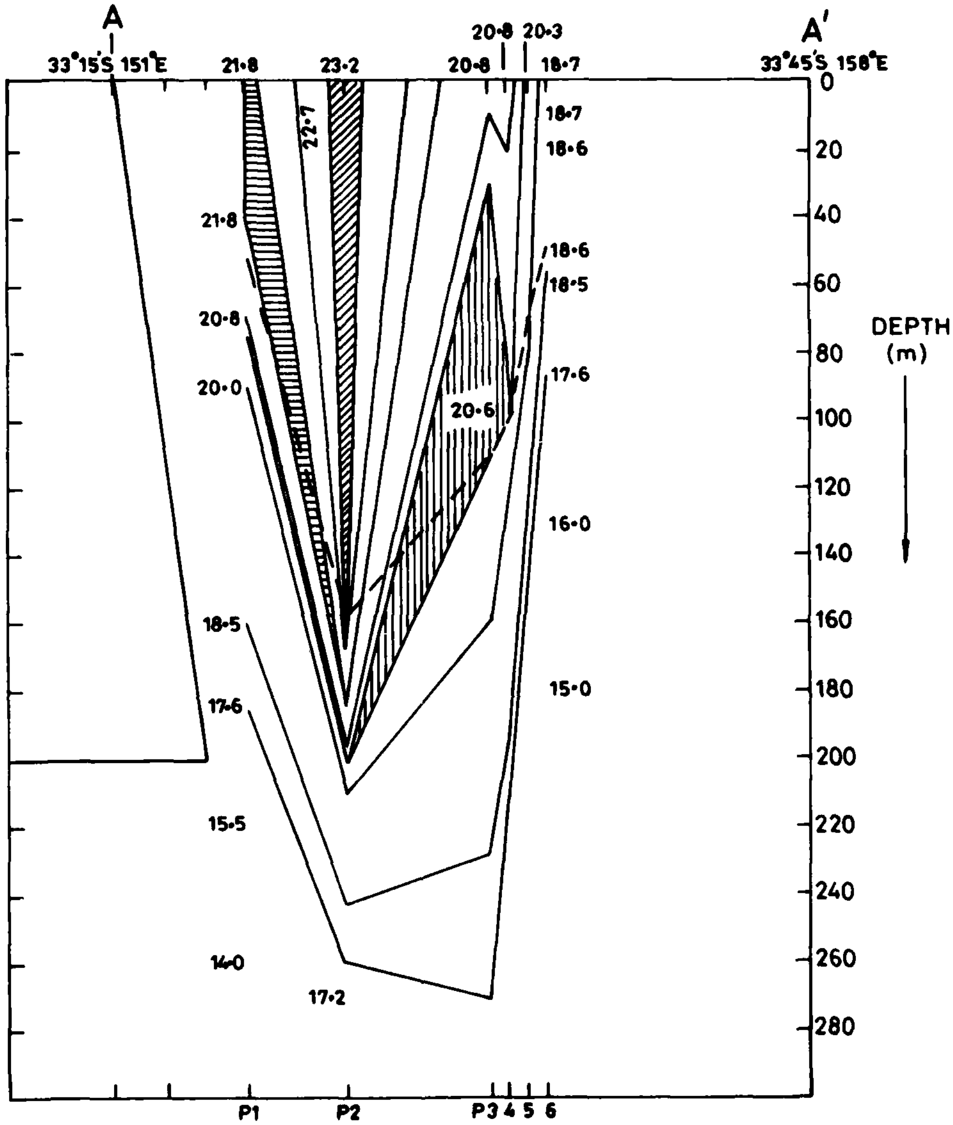


**Fig. 22. Cruise G6/64 (Sept. 16–27, 1964).**

ISOTHERMS (°C) VERSUS DEPTH (m).
DASHED LINE SHOWS MIXED LAYER DEPTH (WATERS WITHIN 0·2°C OF SURFACE TEMPERATURE).

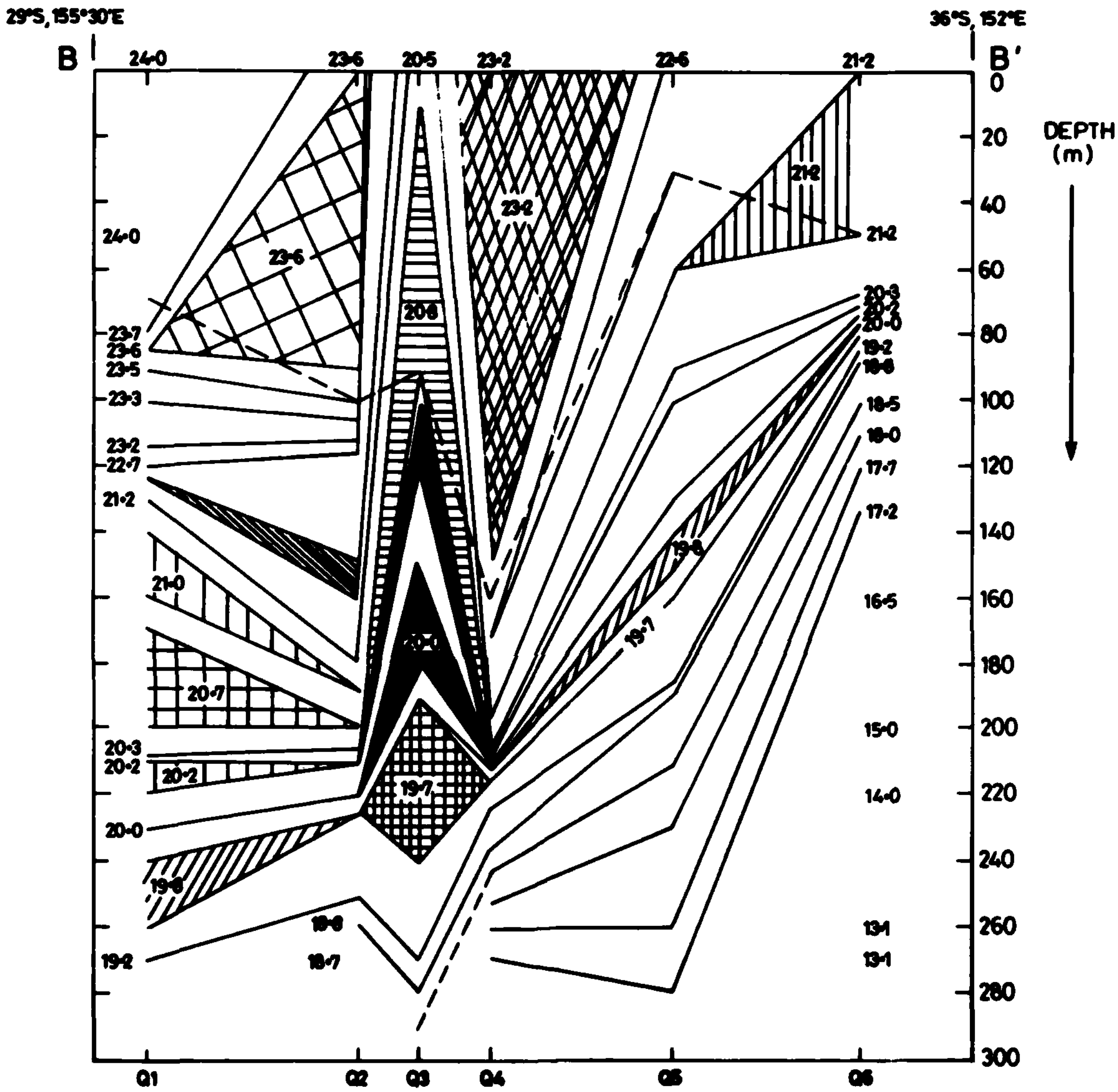


Fig. 23. Cruise G6/64 (Sept. 16–27, 1964).

ISOTHERMS (°C) VERSES DEPTH (m).

DASHED LINE SHOWS MIXED LAYER DEPTH (WATERS WITHIN 0·2°C OF SURFACE TEMPERATURE).


Fig. 24. SST G 9/65. Nov. 1965.

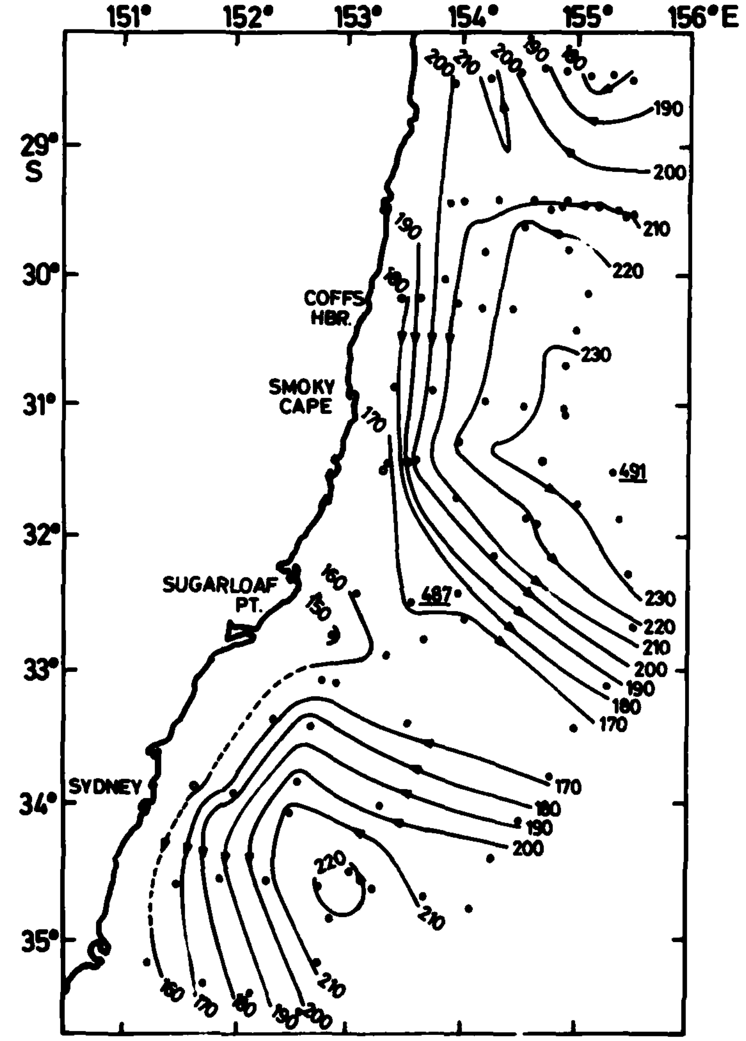


Fig.25. Surface dynamic topography relative to 1300 dbar for Cruise G9/65 (Nov. 15-28, 1965).
• stations with sampling to 1300 m.
• bathythermograph stations to 280 m.

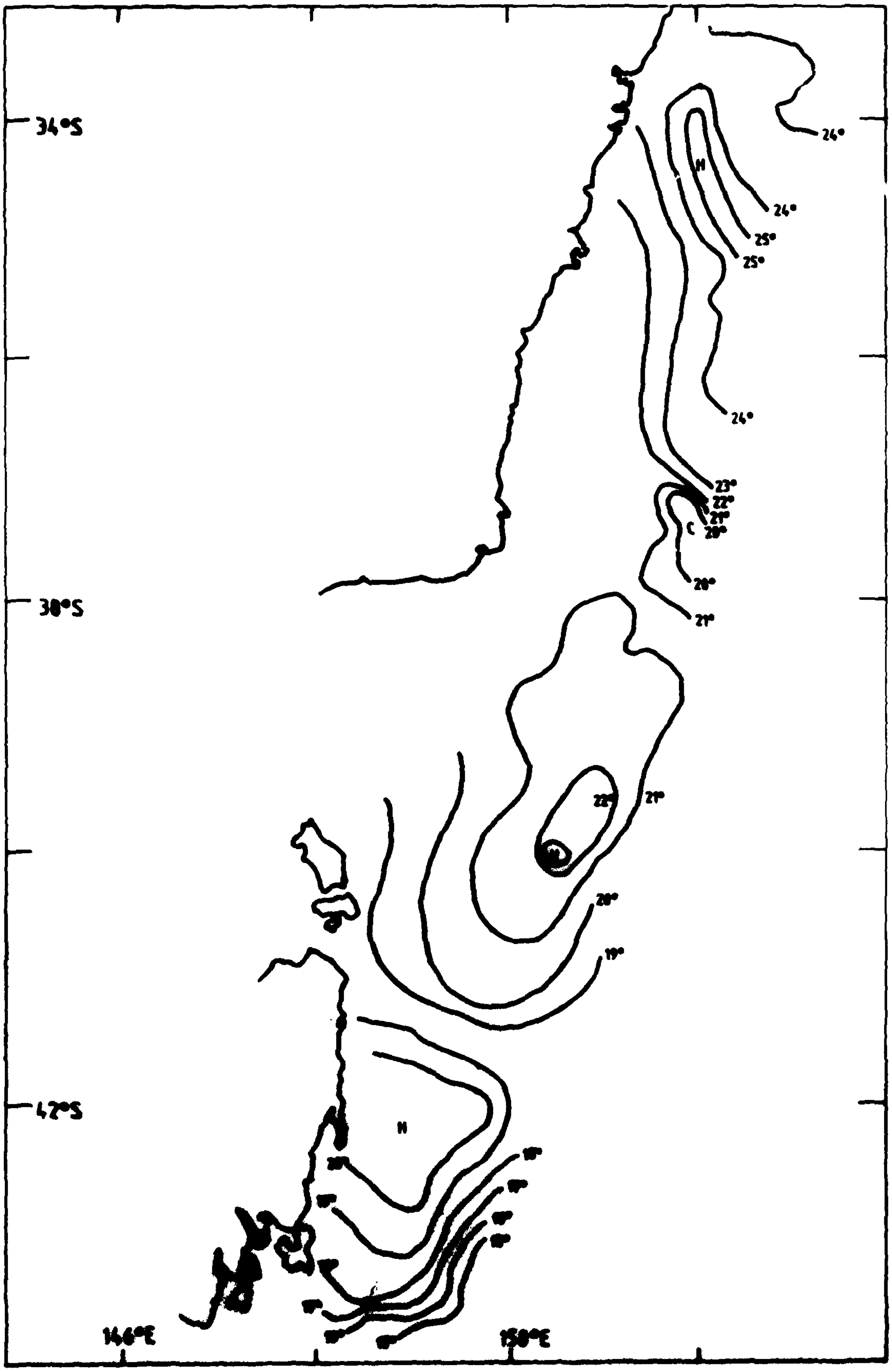


Fig. 26. K3/77/1 Sea-surface temperature 28 Feb-7 Mar. 1977.

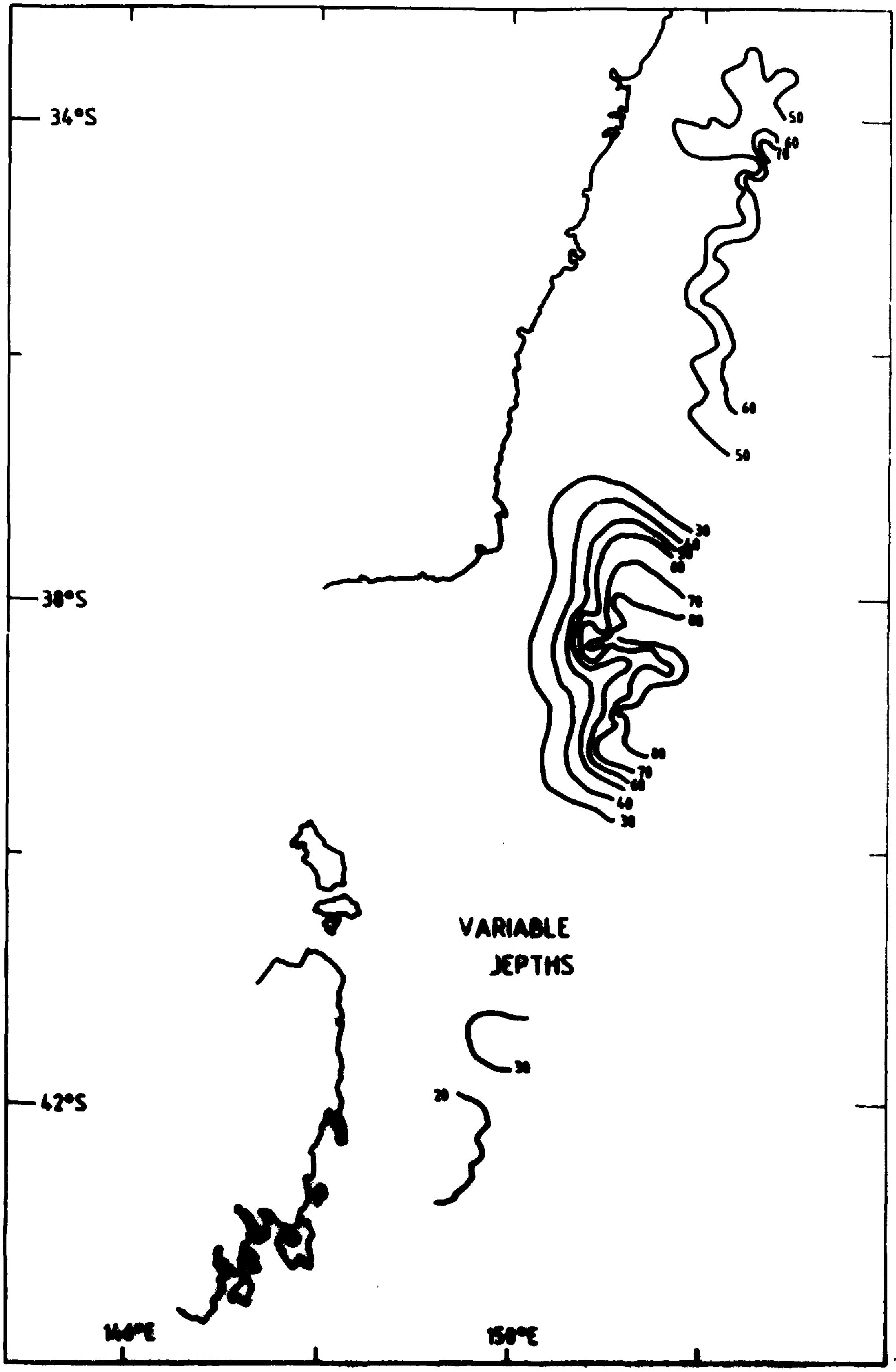


Fig. 27. K3/77/1 Mixed layer depth 28 Feb. 7 Mar. 1977

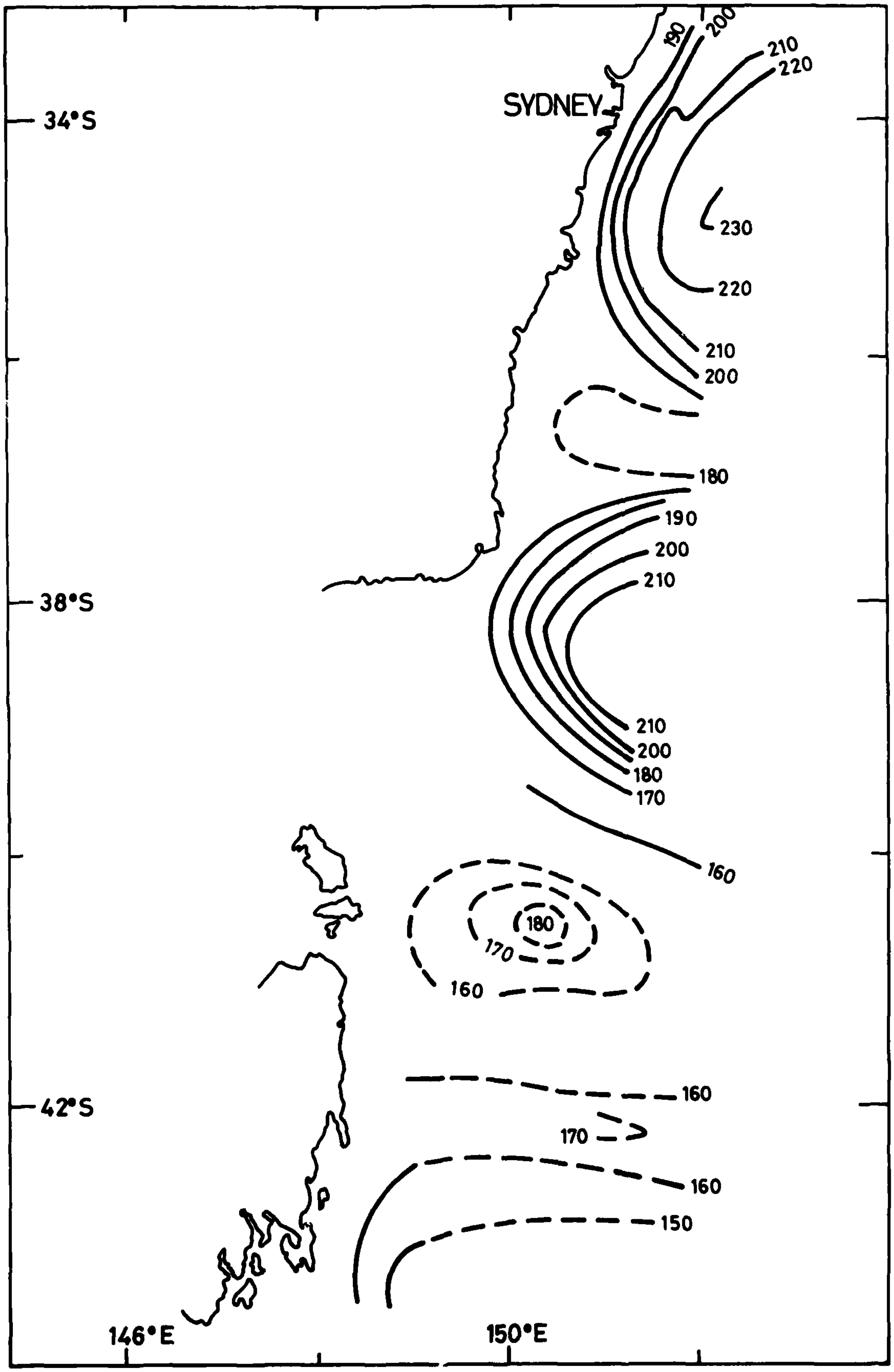


Fig. 27a. K3/77/1 Dynamic Height 28 Feb. 7 March 1977.

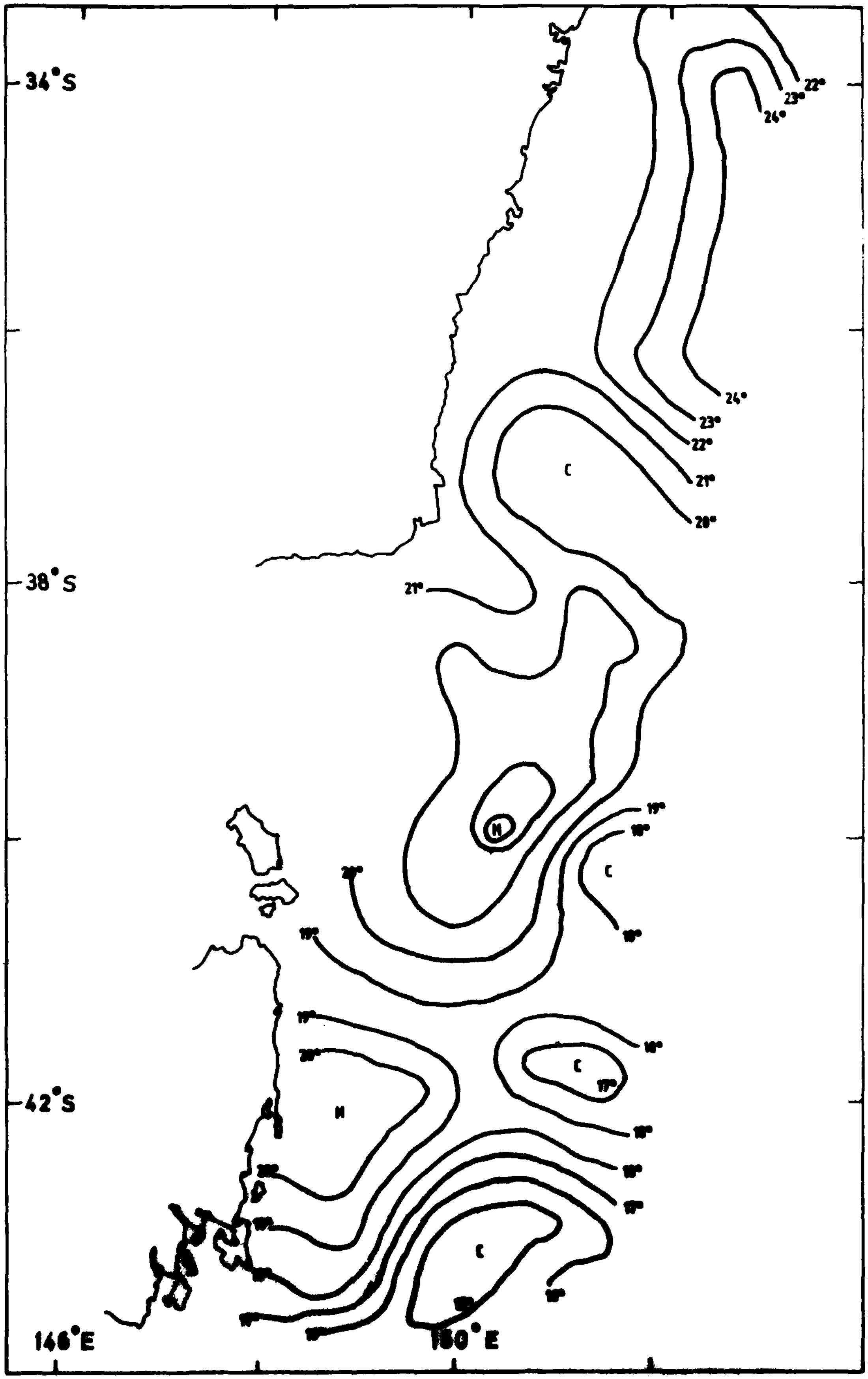


Fig. 20. Sea surface temperature K3/77/2 10-17 March 1977

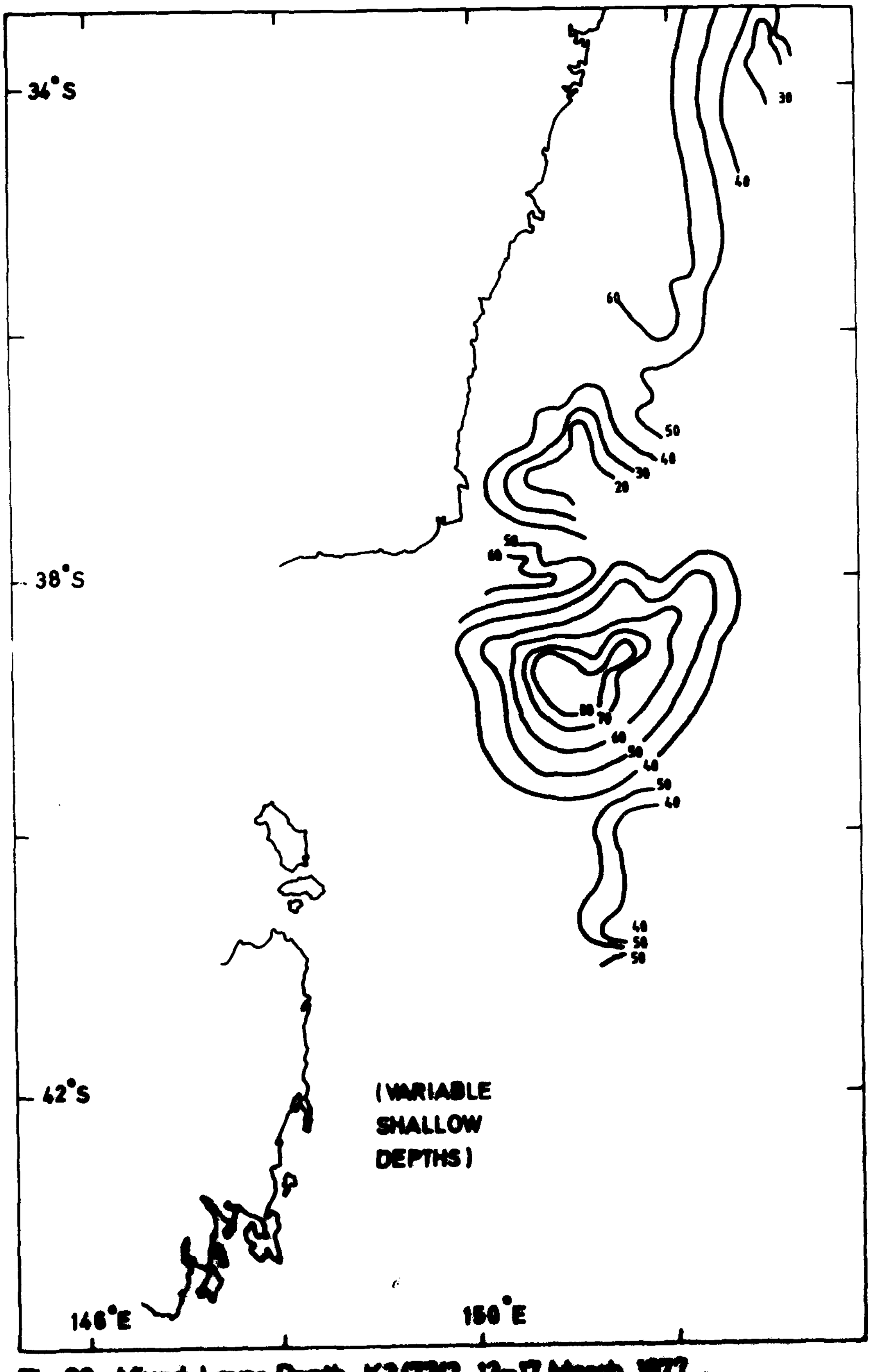


Fig. 28. Mixed Layer Depth. K3/77/2. 13–17 March 1977.

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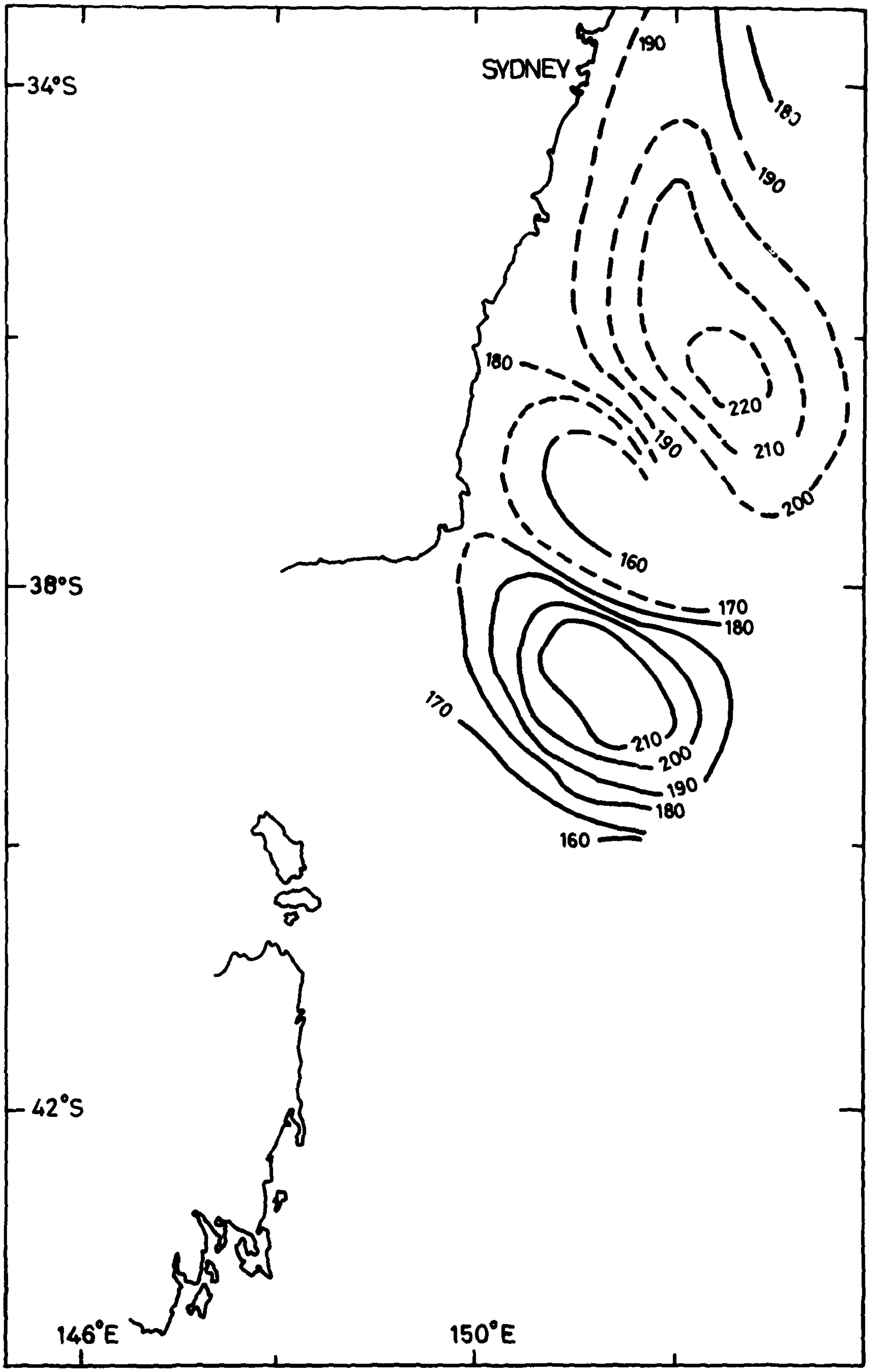


Fig. 29a. Dynamic Height K3/77/2 13-17 March 1977.

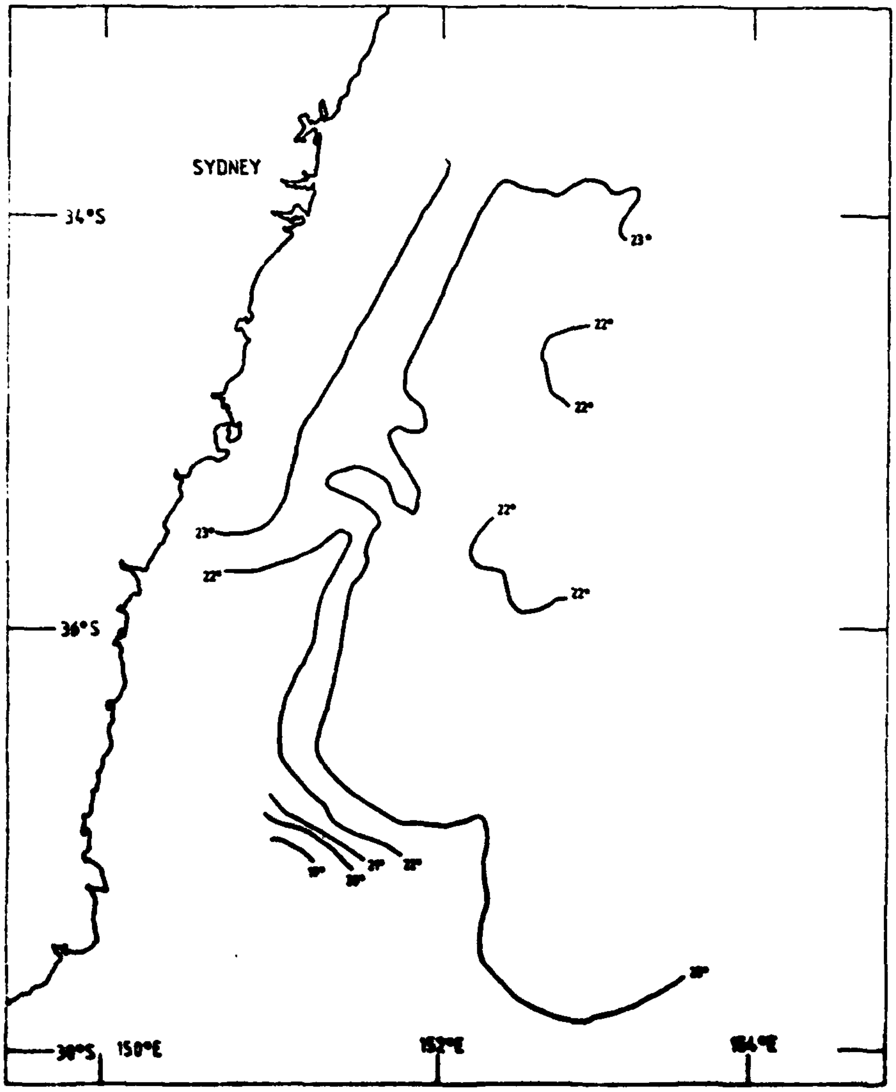


Fig. 30 Sea surface temperature RANRL (6/77) 22-28 March 1977

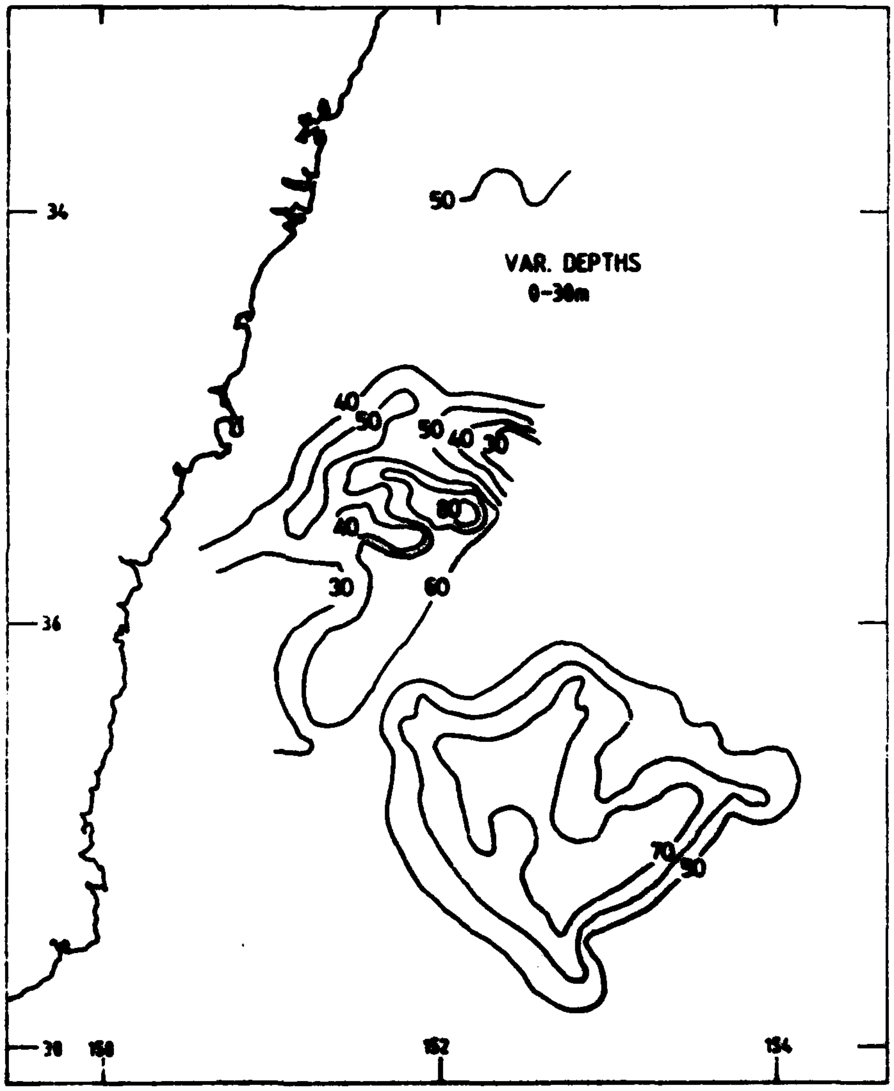


Fig. 31 Mixed layer depth RANRL 6/77 22-28 March 1977.

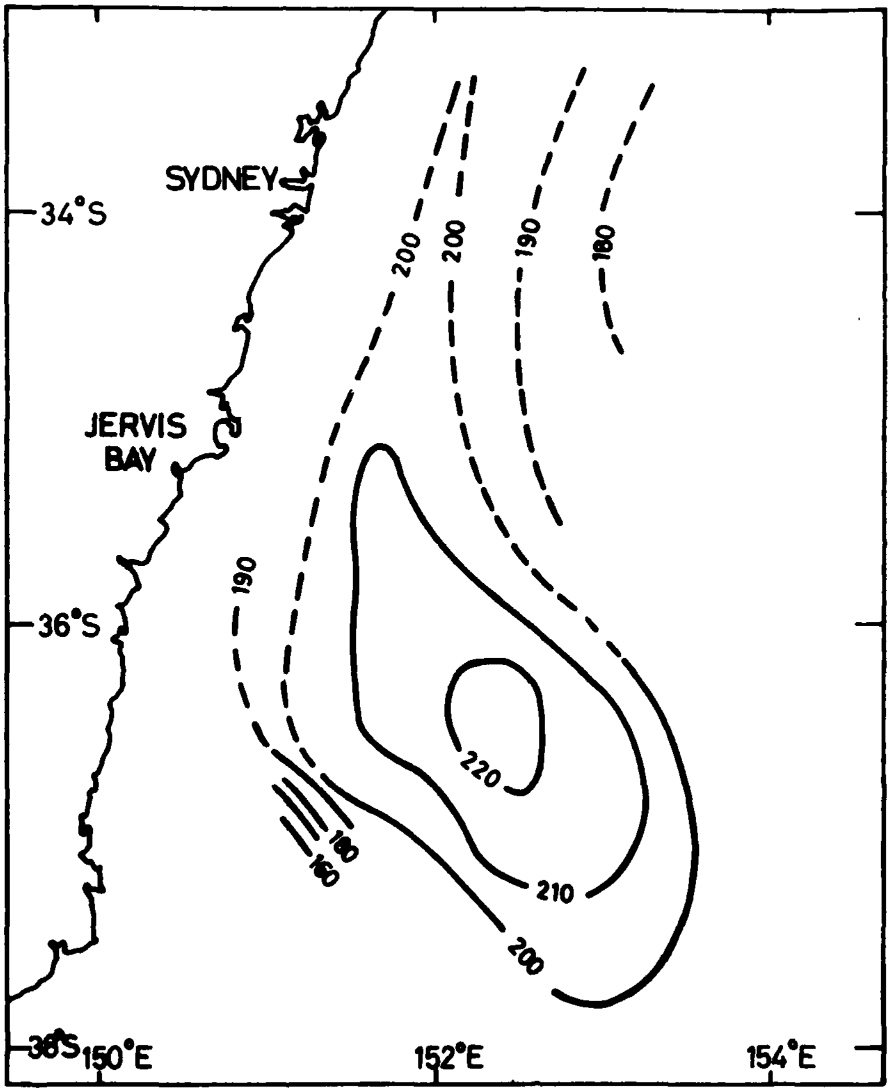


Fig. 31a. Dynamic Height RANRL 6/77
22 - 28 March 1977.

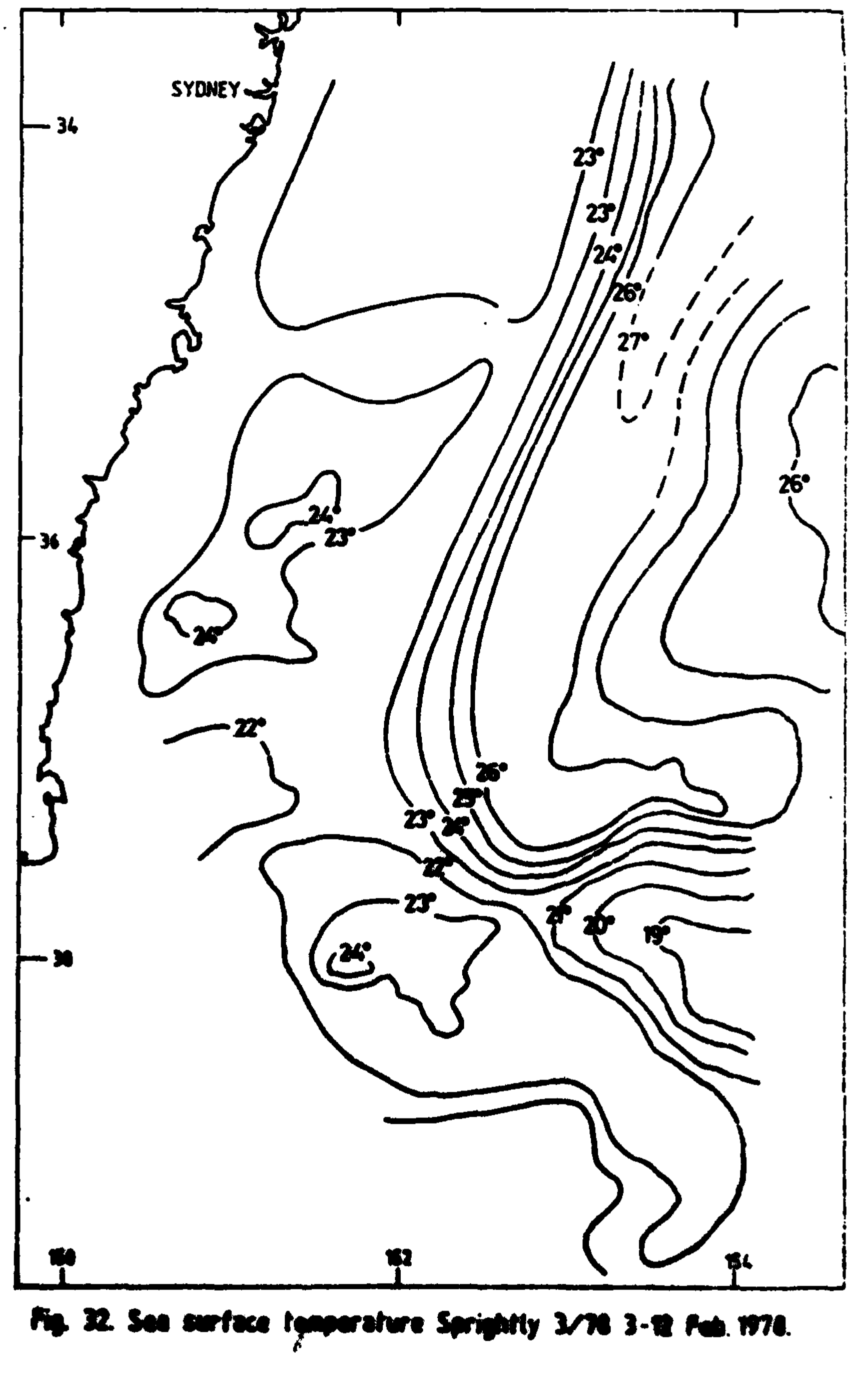


Fig. 32. Sea surface temperature Sprightly 3/78 3-12 Feb. 1978.

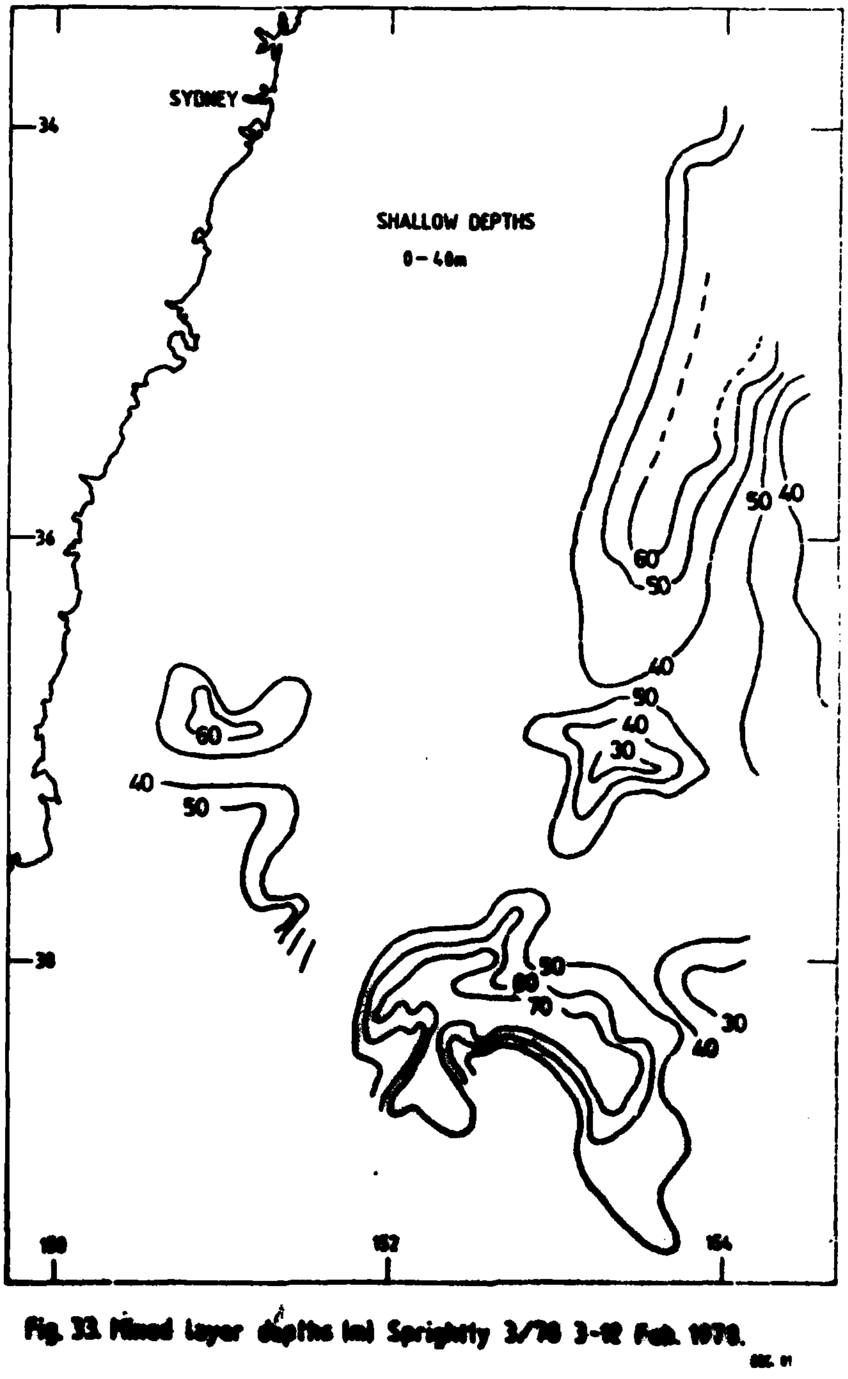


Fig. 33. Mixed layer depths (m) Sprightly 3/78 3-12 Feb. 1978.

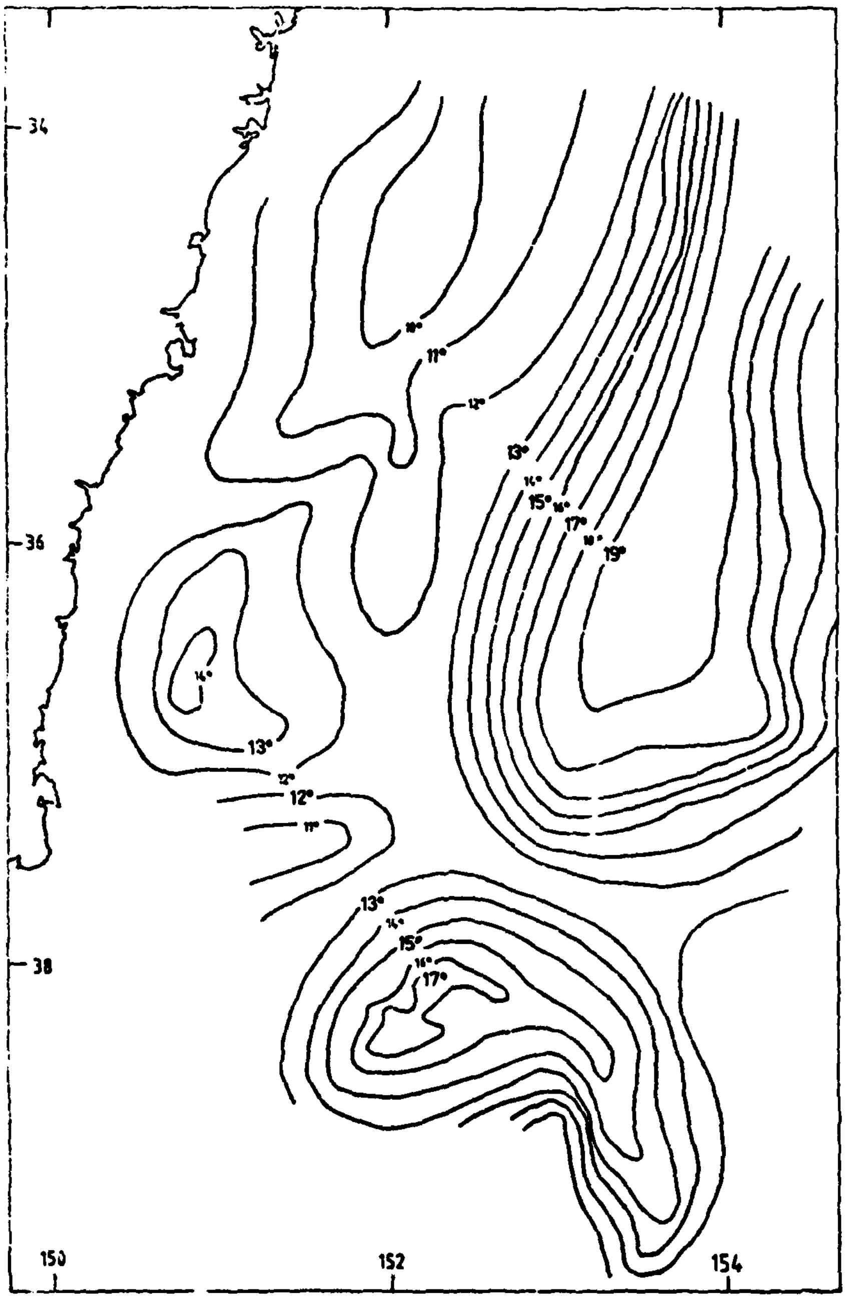


Fig. 34. 250m temperature Sprightly 3/78 3-12 Feb. 1978.

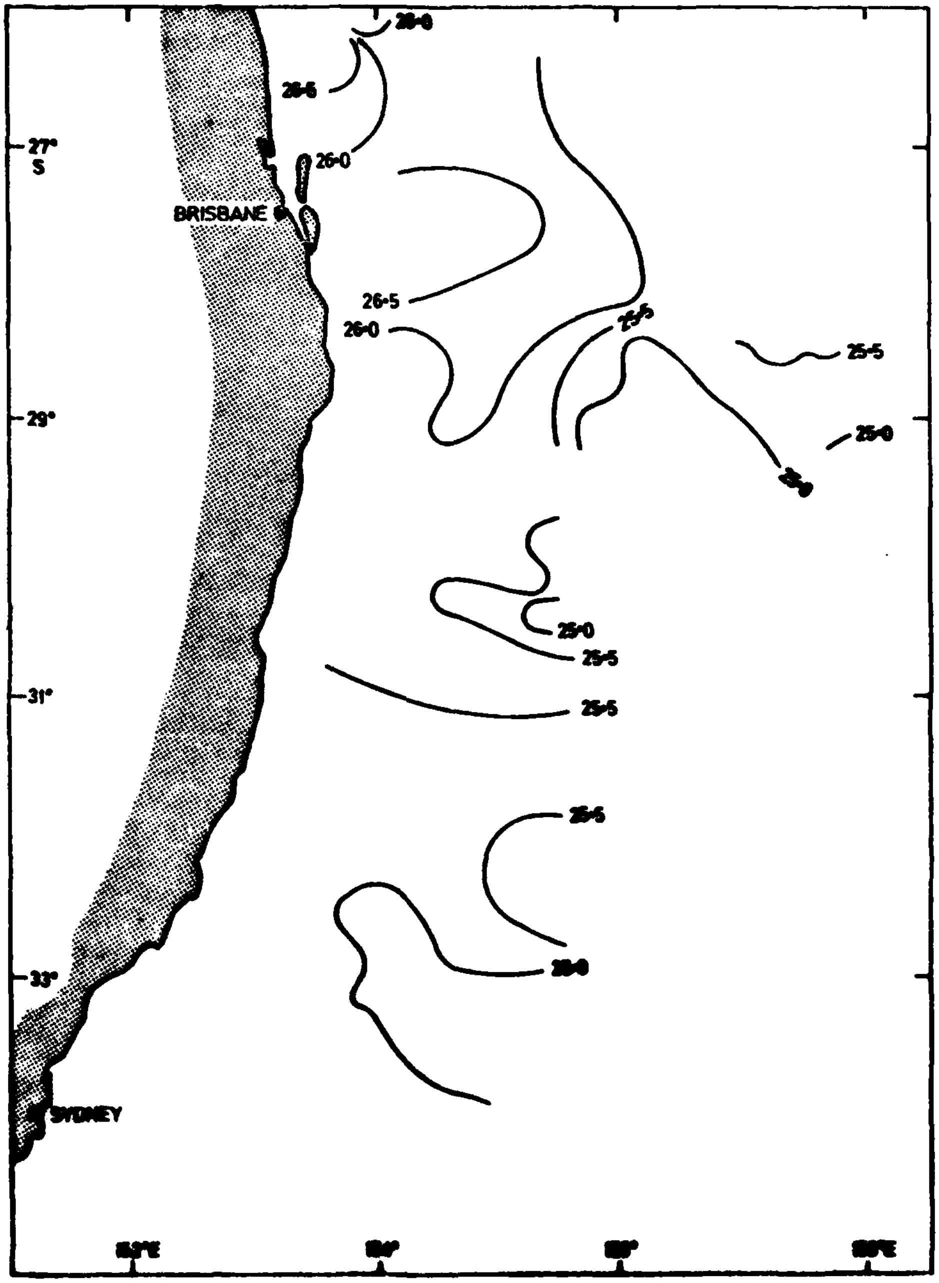


Fig.35. SST (°C). Cruise SP 4/78. 8–22 March 1978.

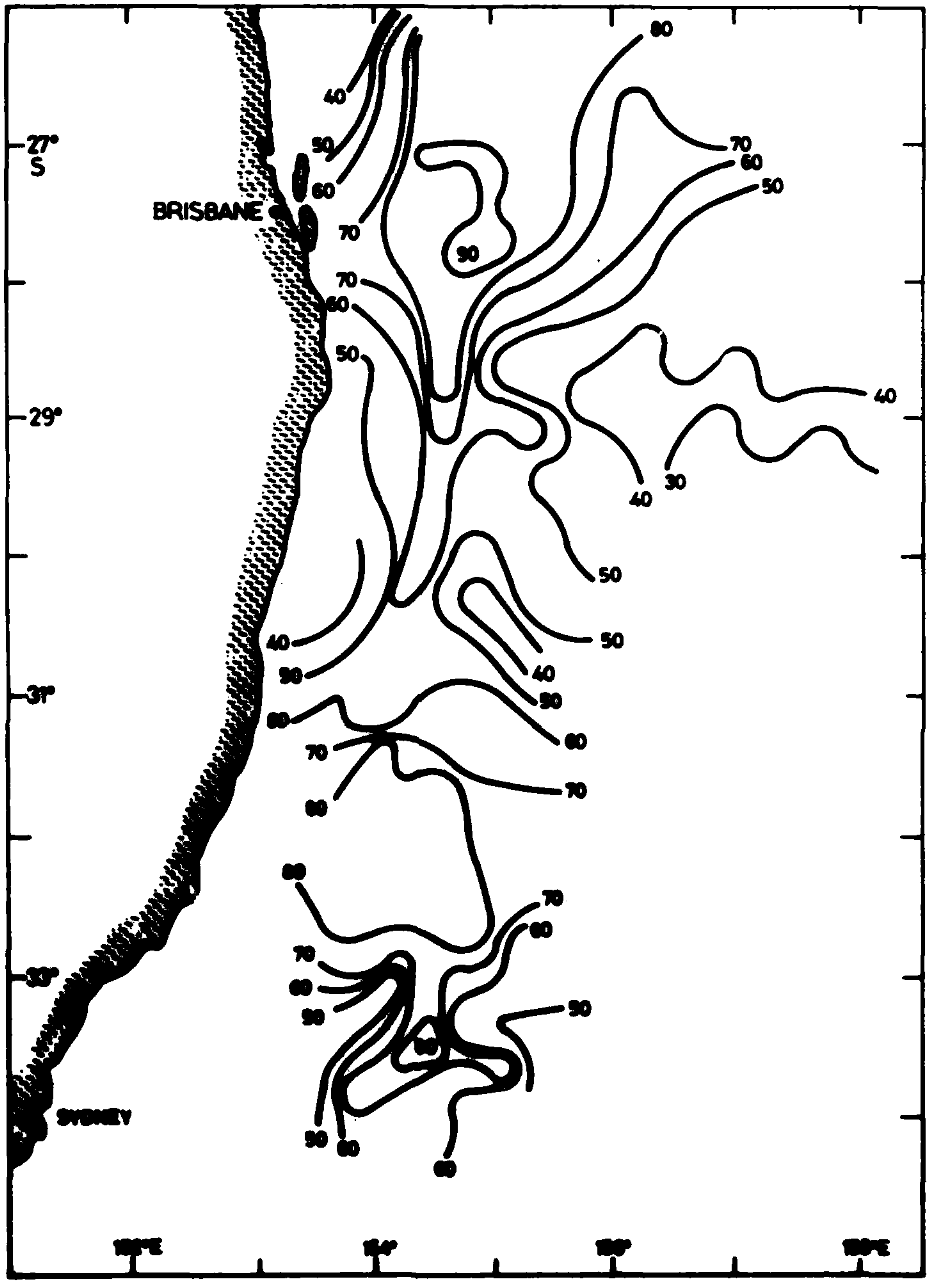


Fig.36. MLD. Cruise SP4/78. 8-22 March 1978.

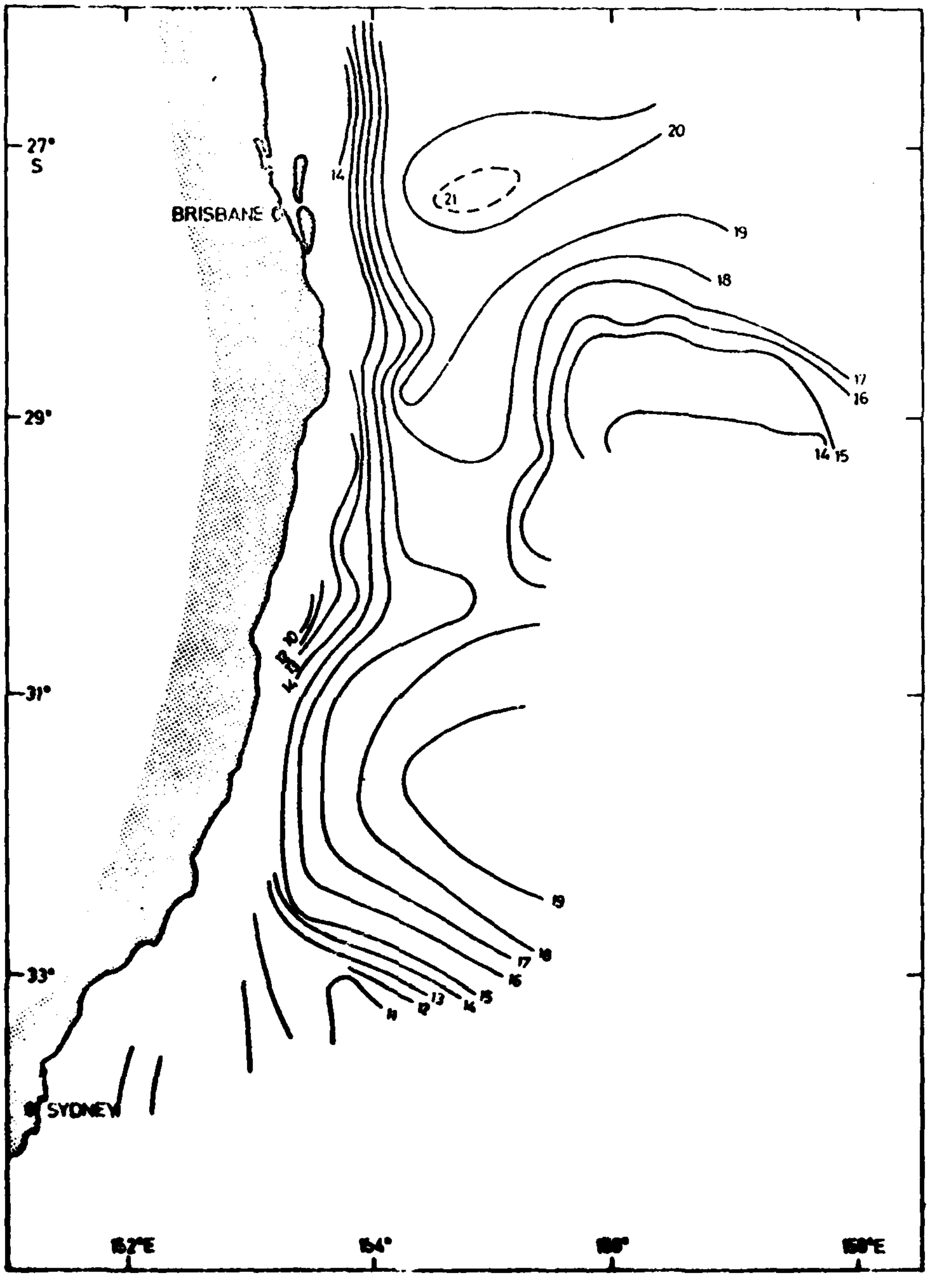


Fig. 37. $T_{250}$ (°C). Cruise SP 4/78.

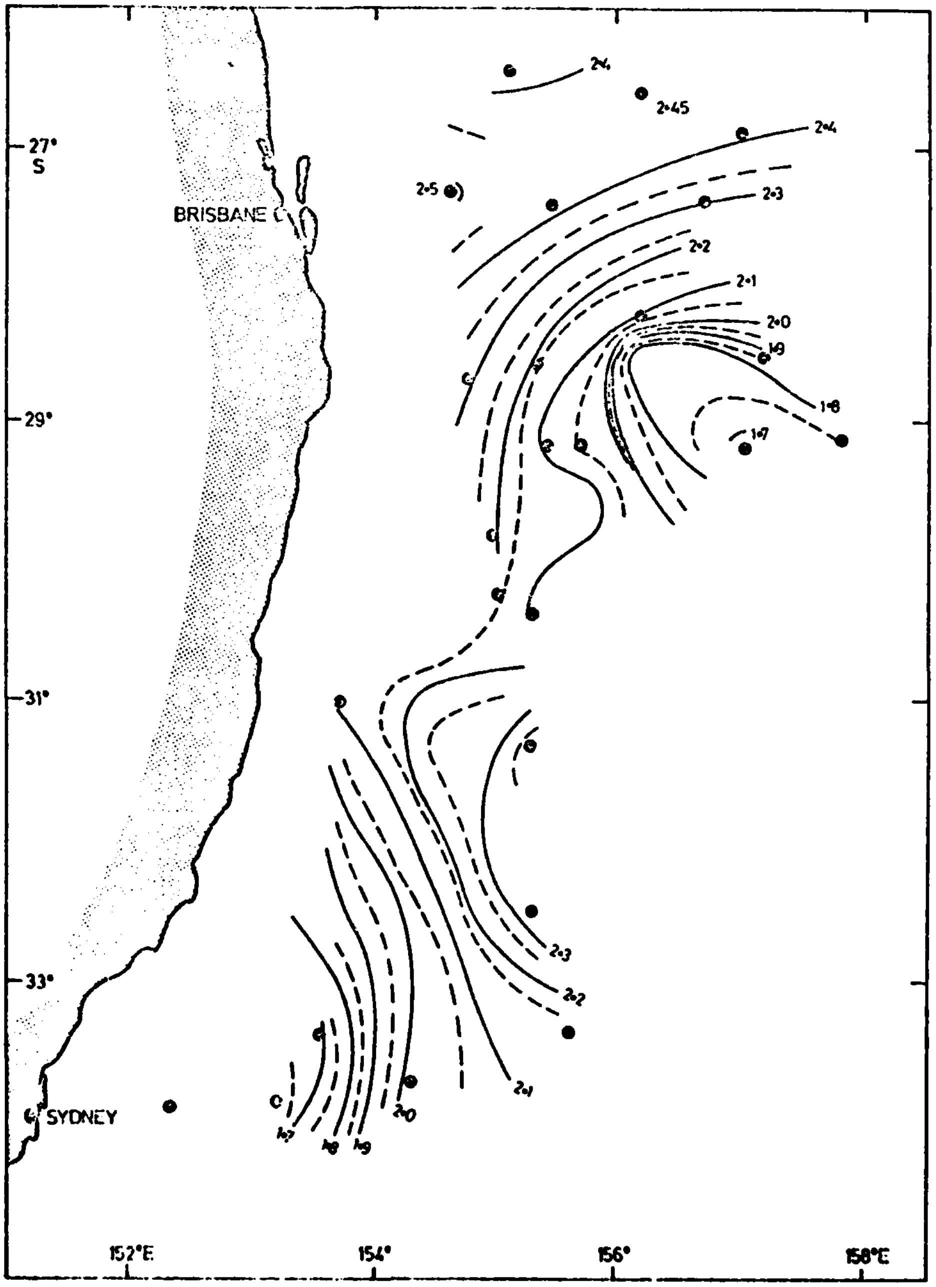


Fig. 38. Dynamic Height relative to 1300 m. Cruise SP 4/78.

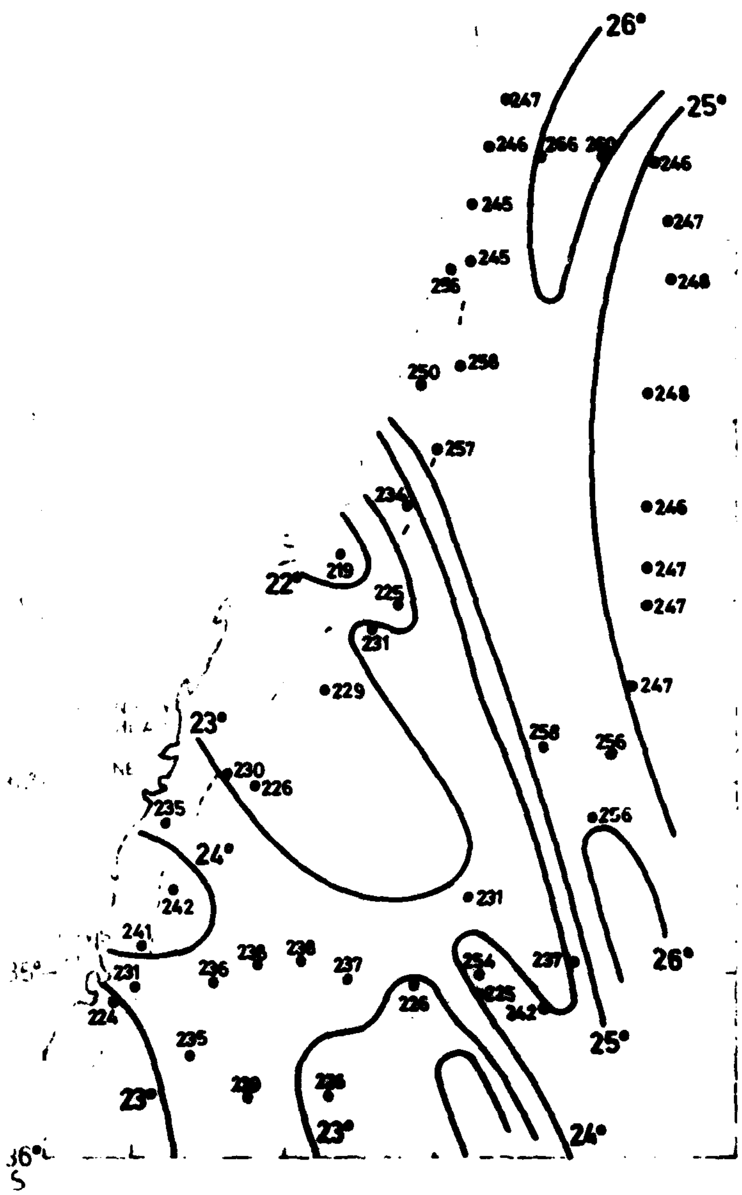


Fig.39. SST. Sp5/78 & Sp 6/78. Mar.—Apr. 1978.

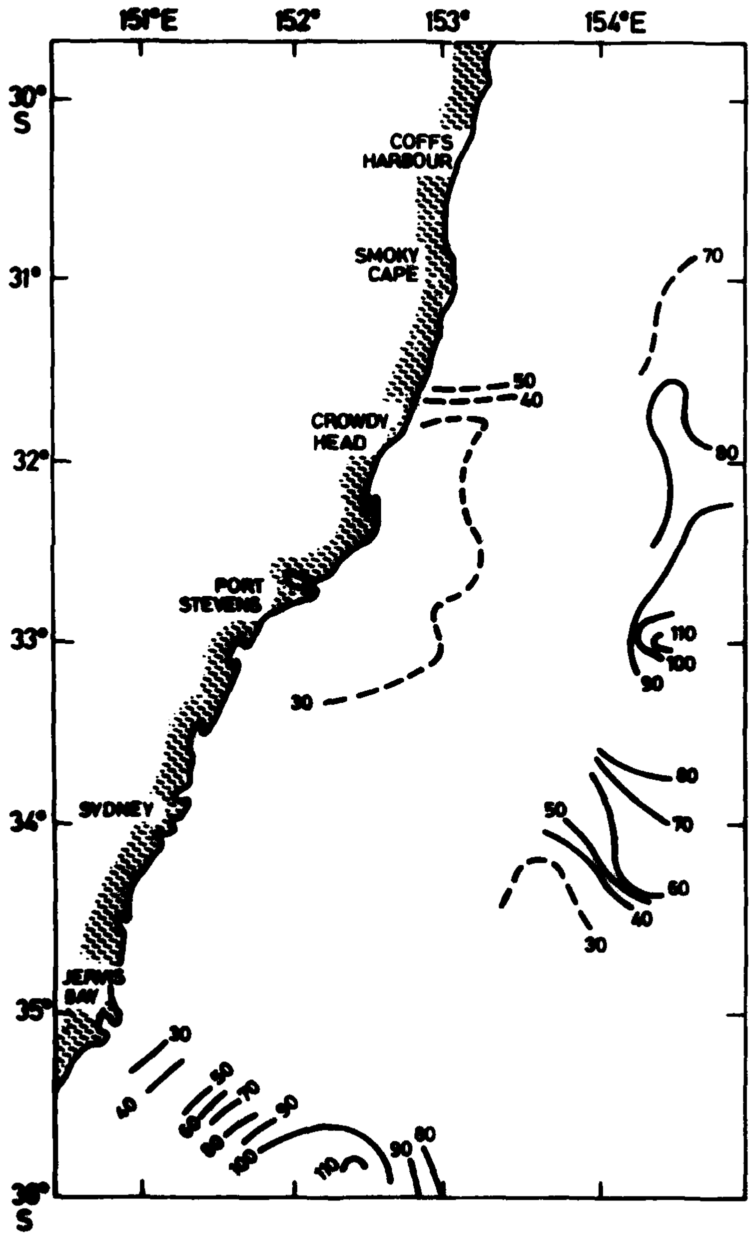


Fig. 40. MLD. SP5/78 & SP6/78. Mar.-Apr. 1978.

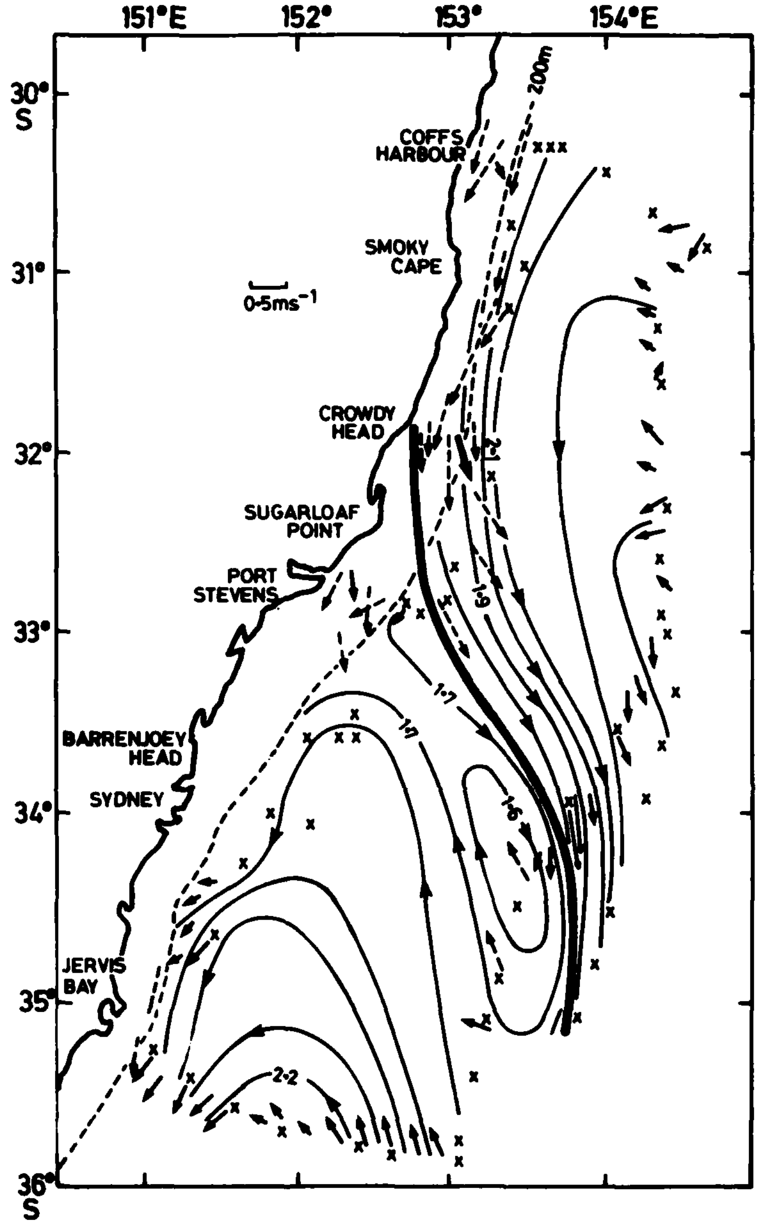


Fig. 41. Results of Sprightly cruises Sp 5/78 & Sp 6/78, 30 Mar. — 11 Apr. 1978. Light full lines are contours of surface dynamic height relative to 1300 db. The heavy full line shows the position of a surface temperature front, from a satellite photo of 11 April. Full arrows are currents measured by GEK, dashed arrows currents measured by ship's drift. The heavy full arrow off Crowdy Head is the 11-day average of a current meter record.

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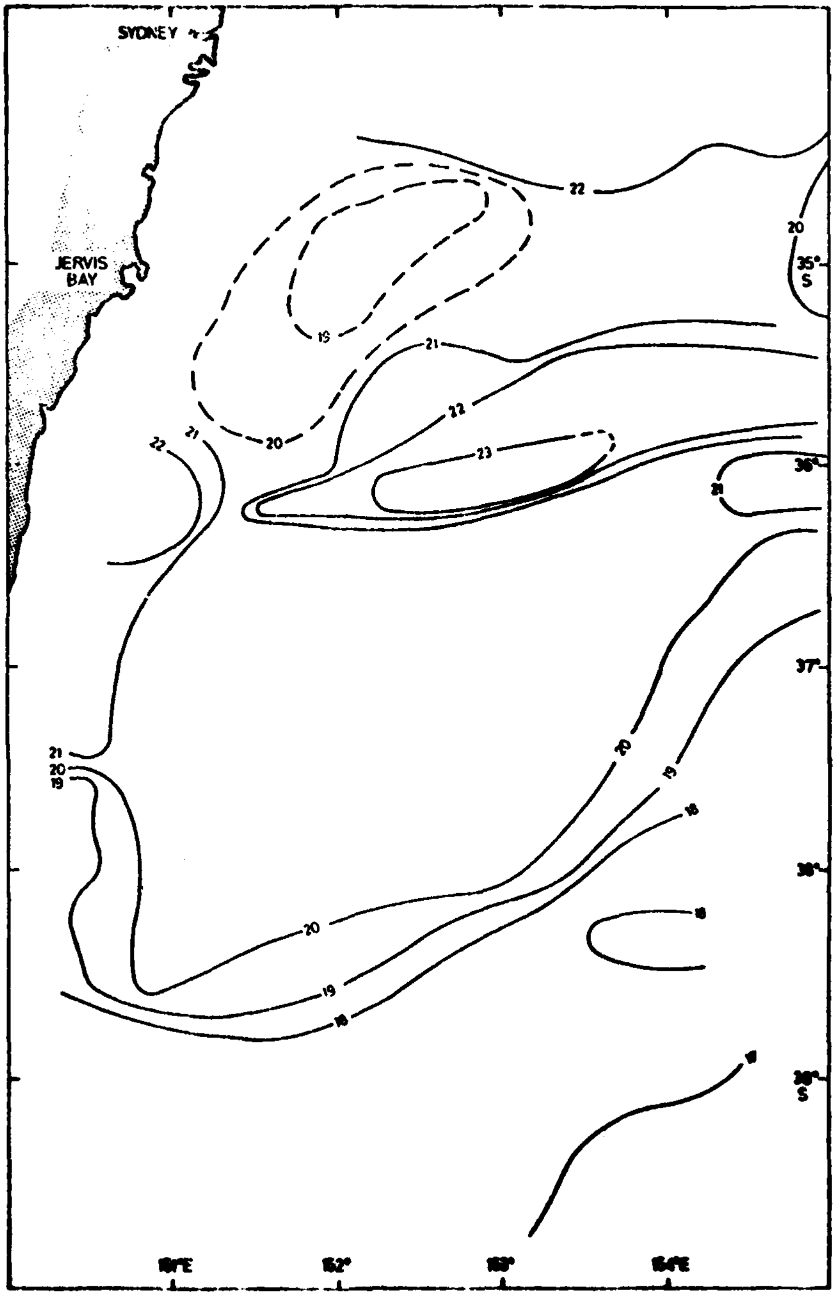


Fig. 42. SST (°C). Cruise SP 6/78. 22 May – 6 June 1978.

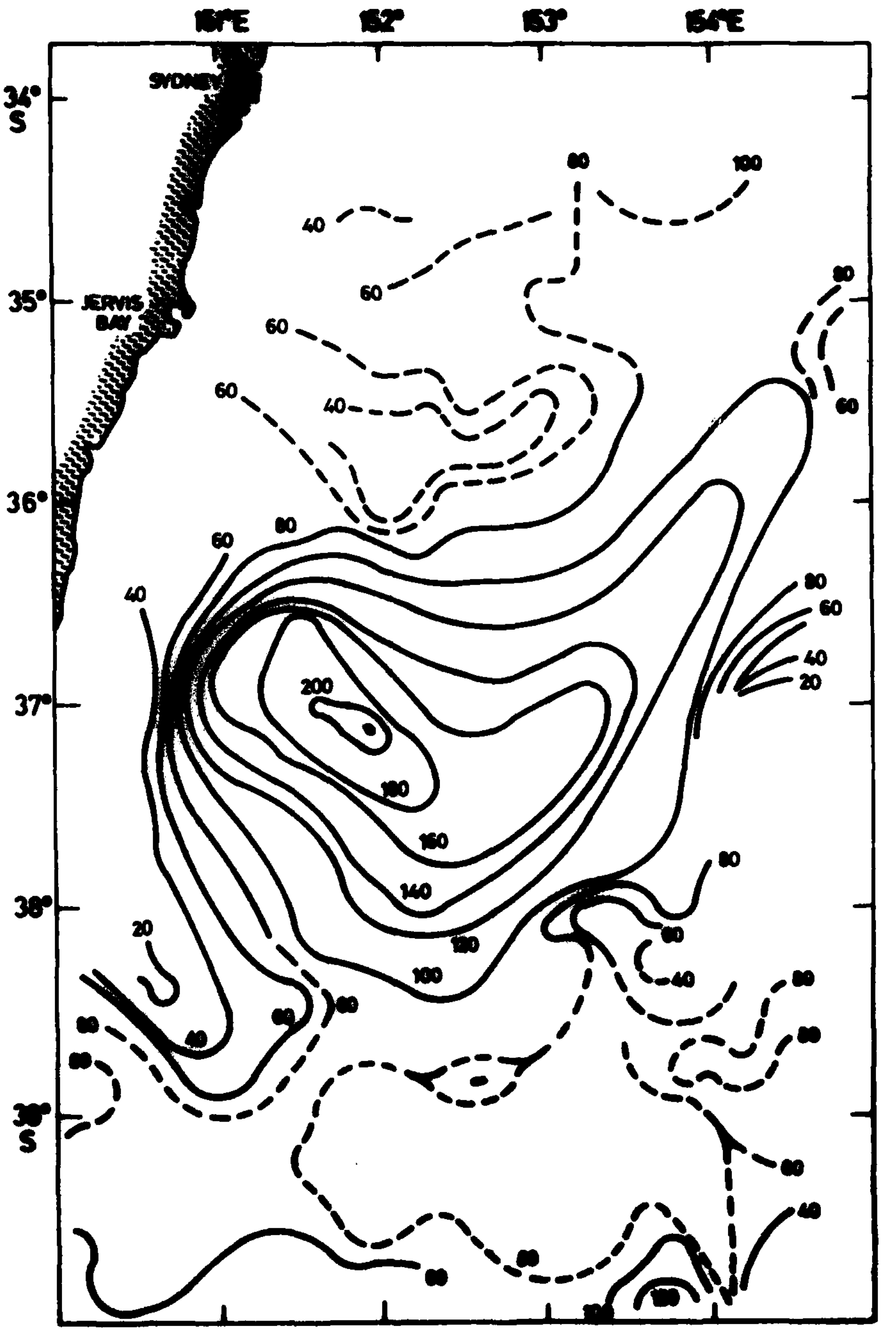


Fig. 43. MLD. Cruise SP 8/78. 22 May–6 June 1978.

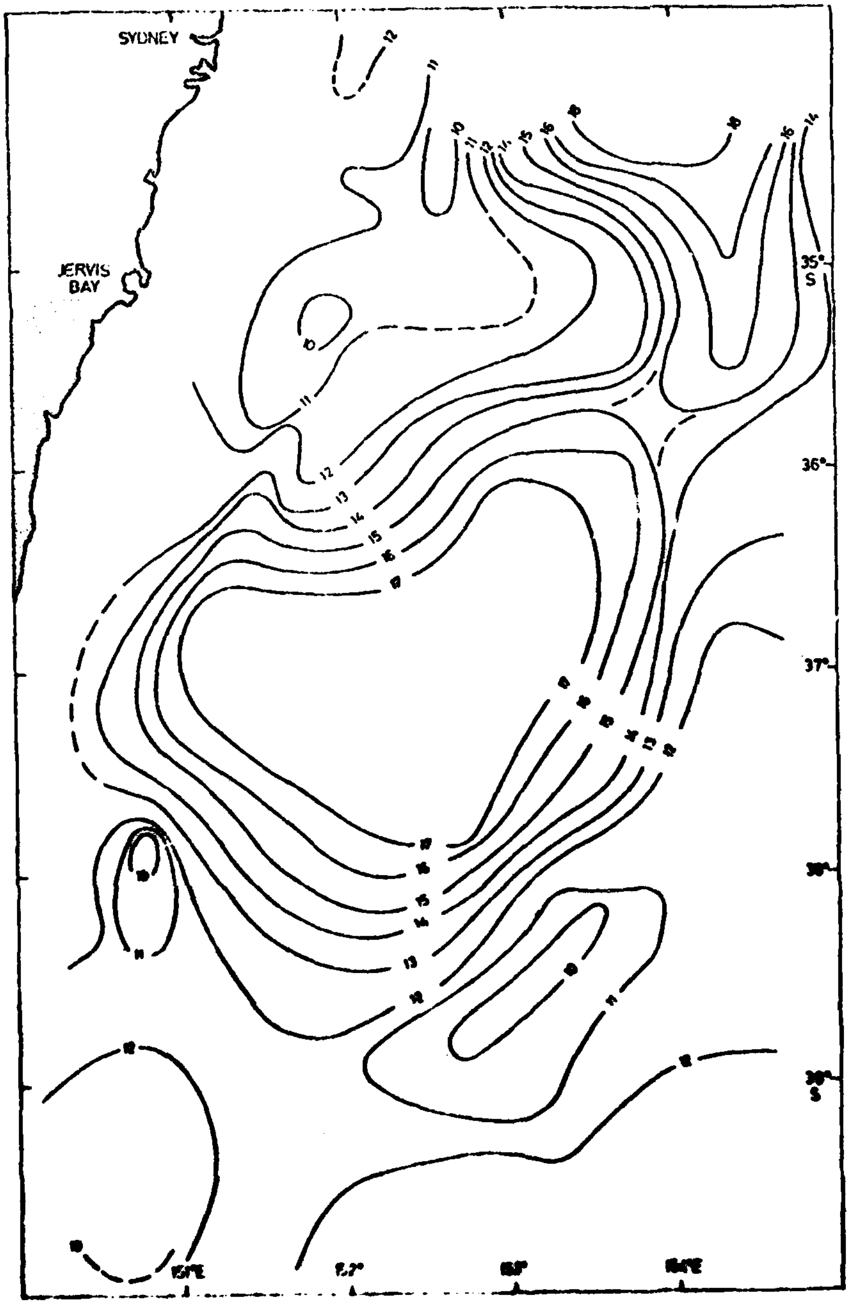


Fig. 44. $T_{250}$ (°C). Cruise SP 6/78.

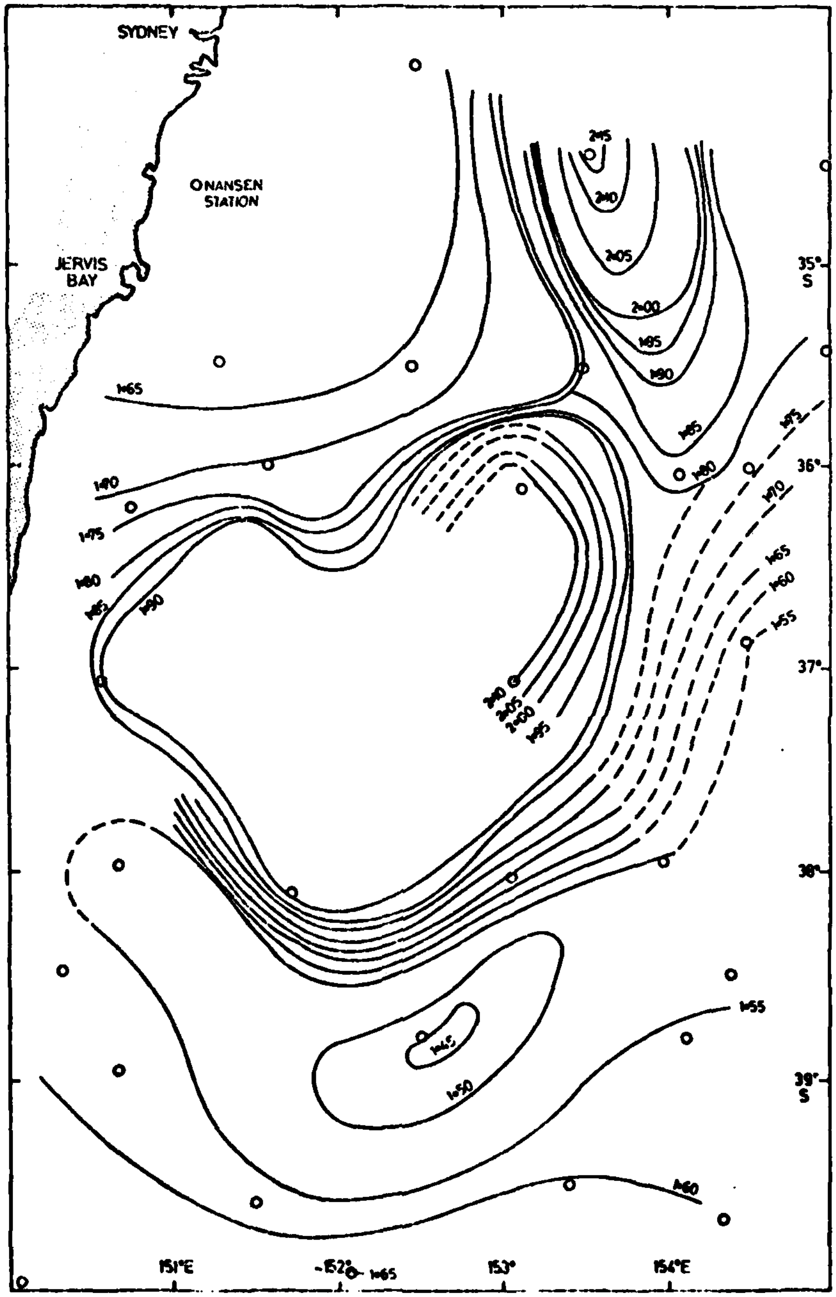


Fig. 45. Dynamic Height relative to 1300m. Cruise SP 8/78.

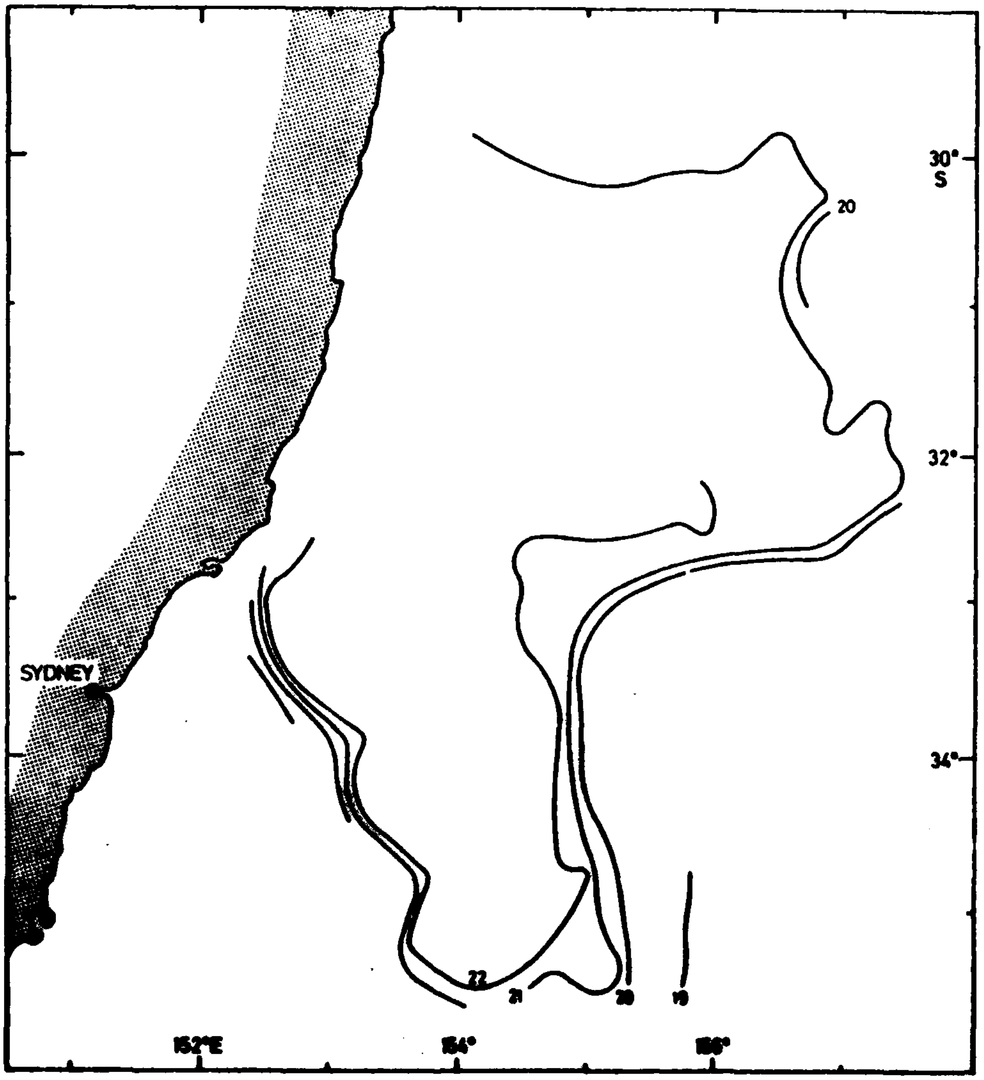


Fig. 46. SST (°C). Cruise SP 9/78. 8-19 June 1978.

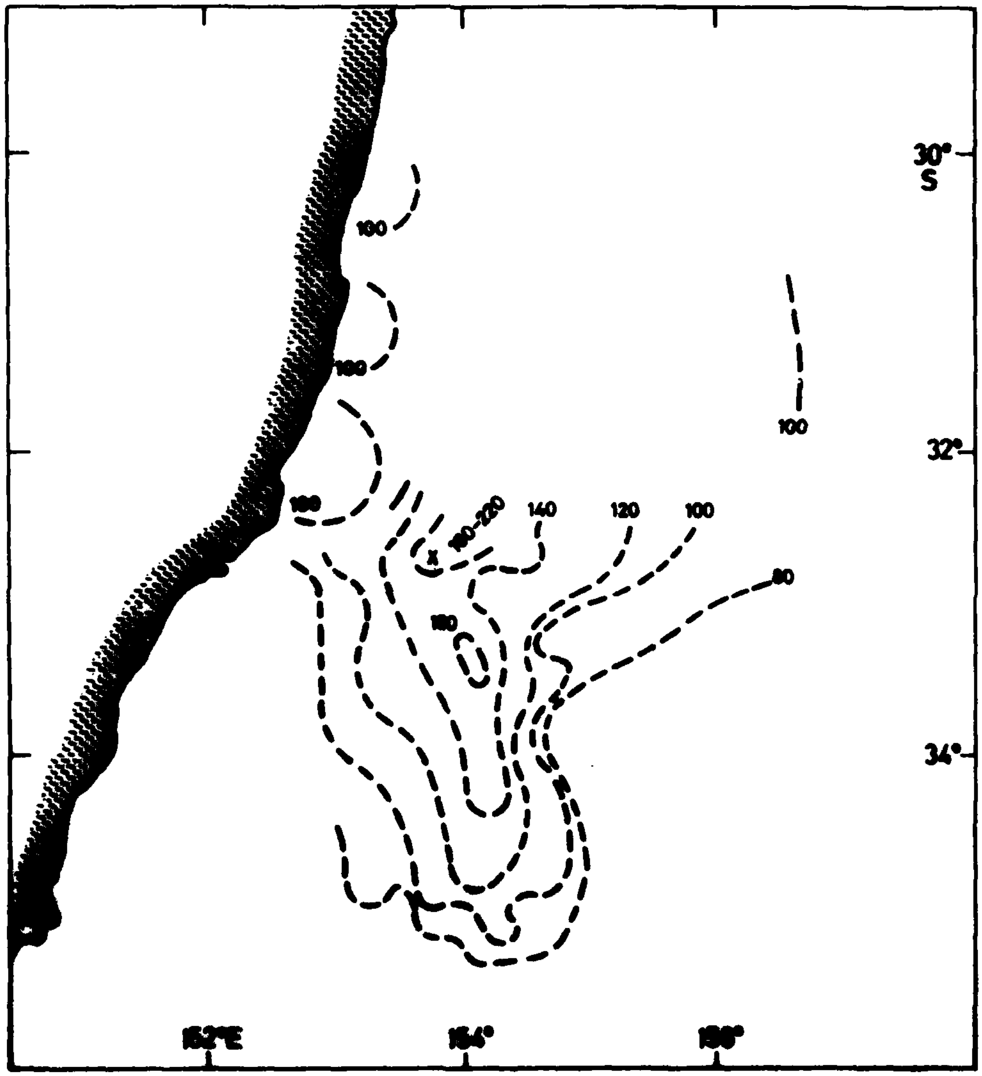


Fig. 47. MLD. Cruise SP9/78. 8-19 June 1978.
(Speculative contours).

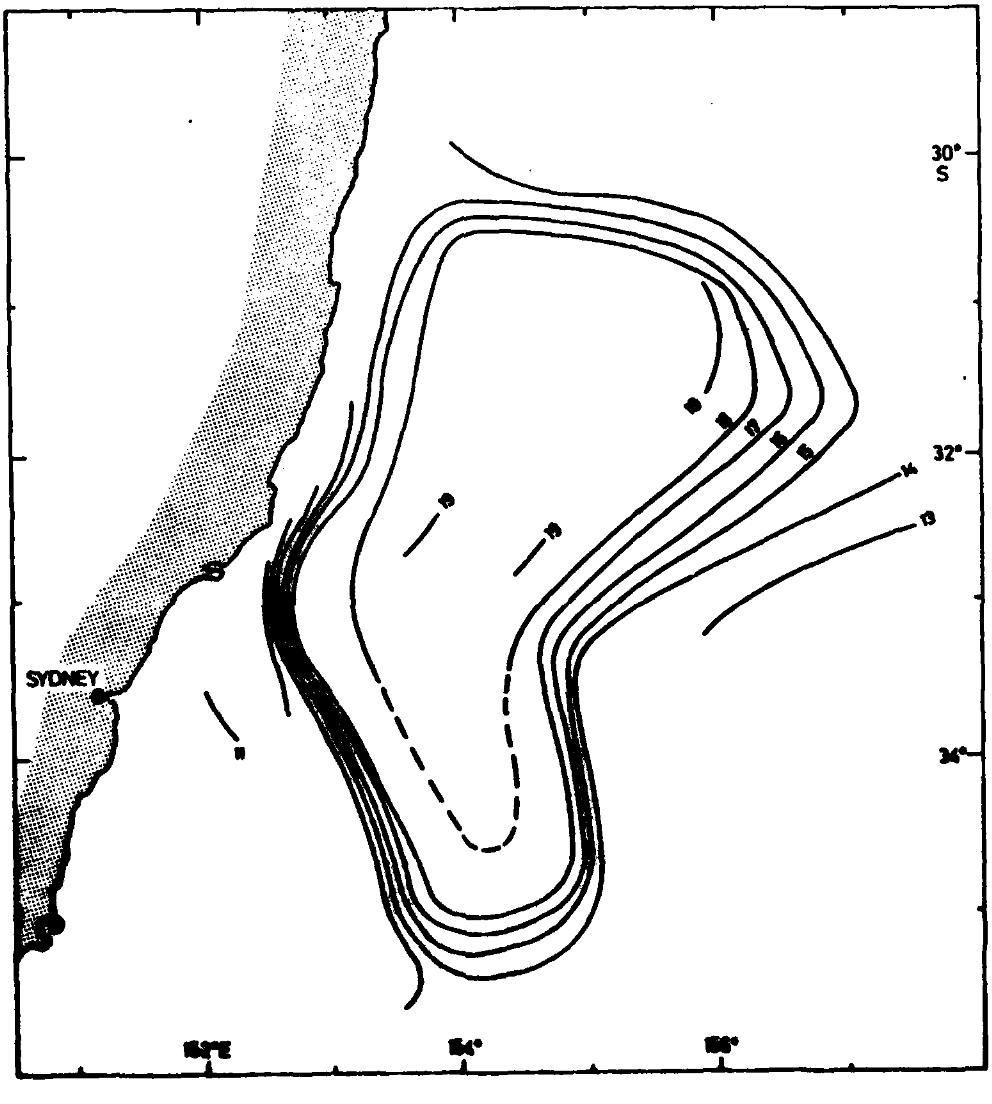


Fig. 40. $T_{250}$ (°C). Cruise SP 9/78.

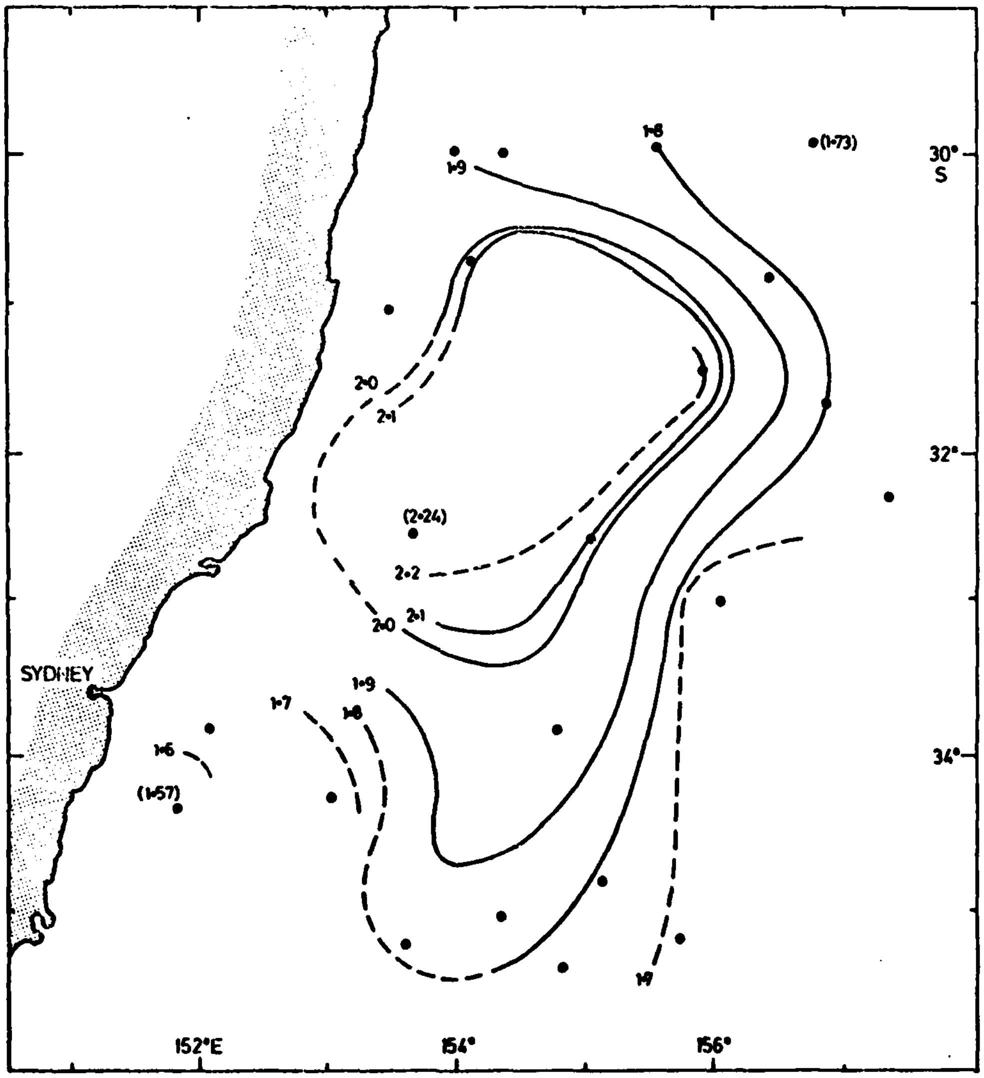


Fig. 49. Dynamic Height relative to 1300 m. Cruise SP 9/78.

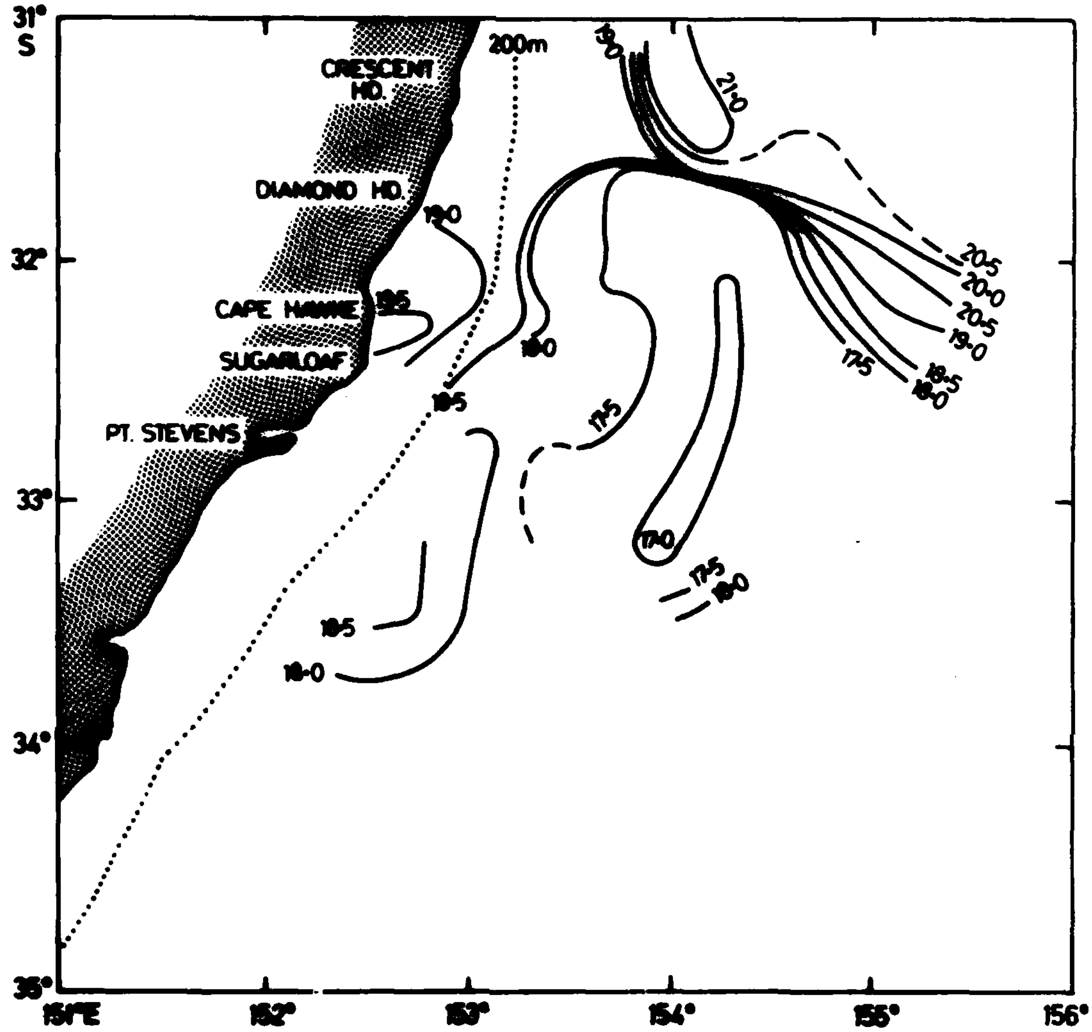


Fig. 50. SST (°C). Cruise SP 10/78. 20 Jul. – 4 Aug. 1978.

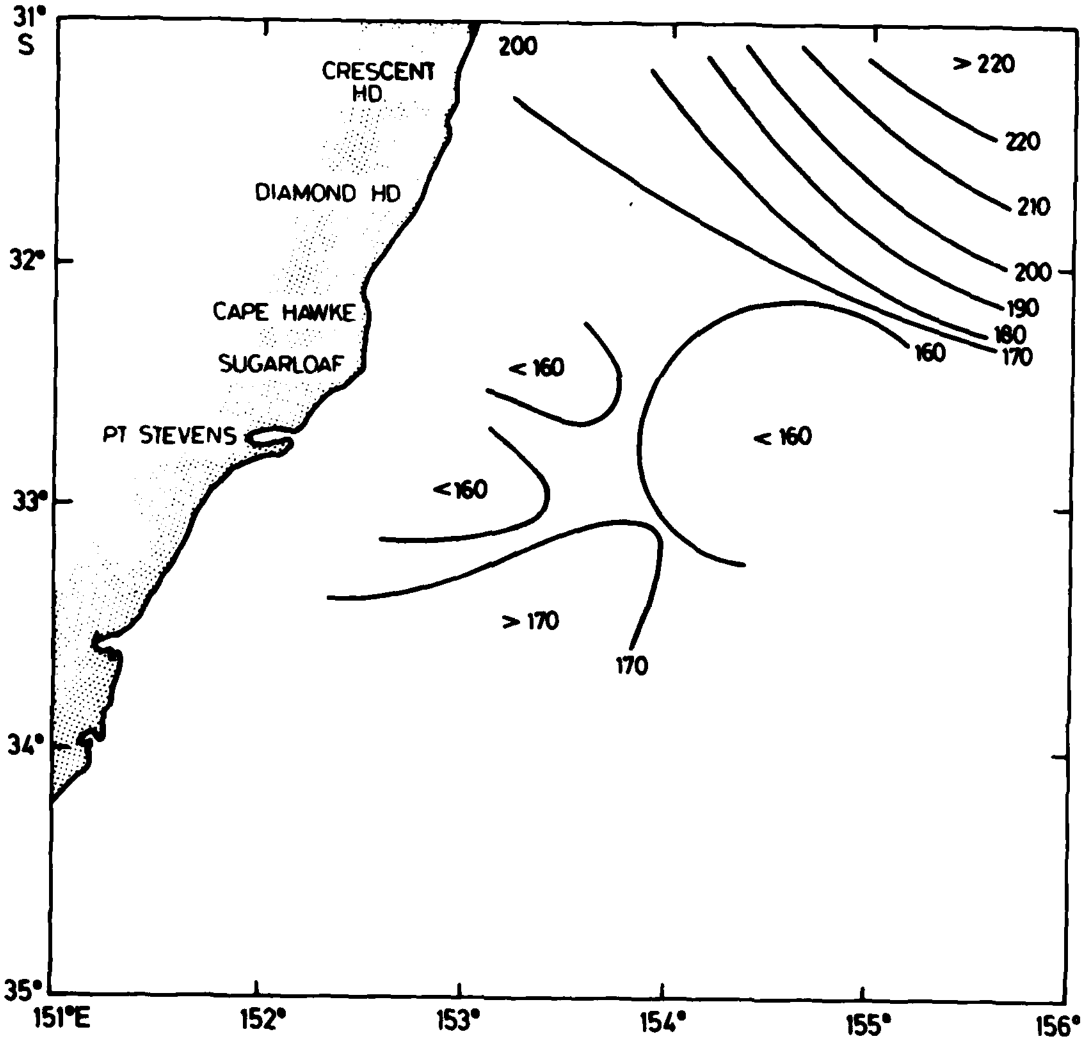


Fig. 51. Dynamic Height relative to 1300m. Cruise SP 10/78.

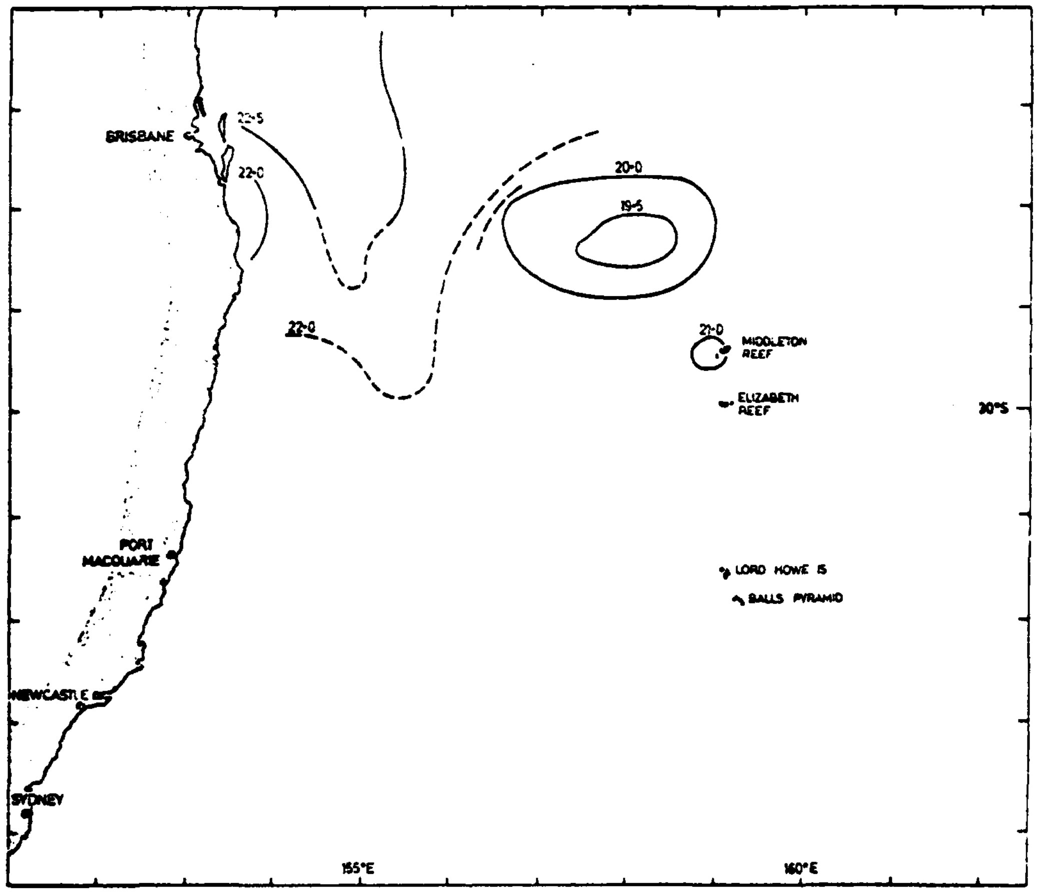


Fig. 52. SST (°C). Cruise SP 11/78. 5–18 Aug. 1978.

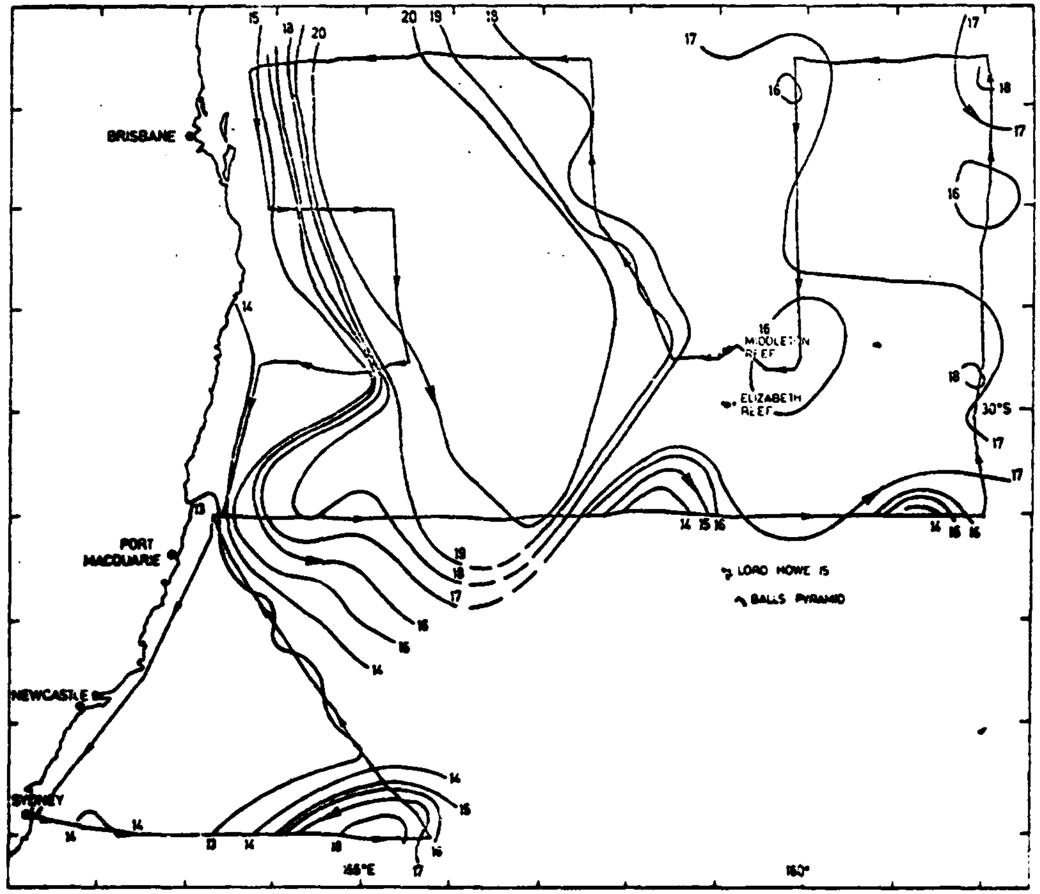


Fig.53. $T_{250}$. Cruise SP 11/78.

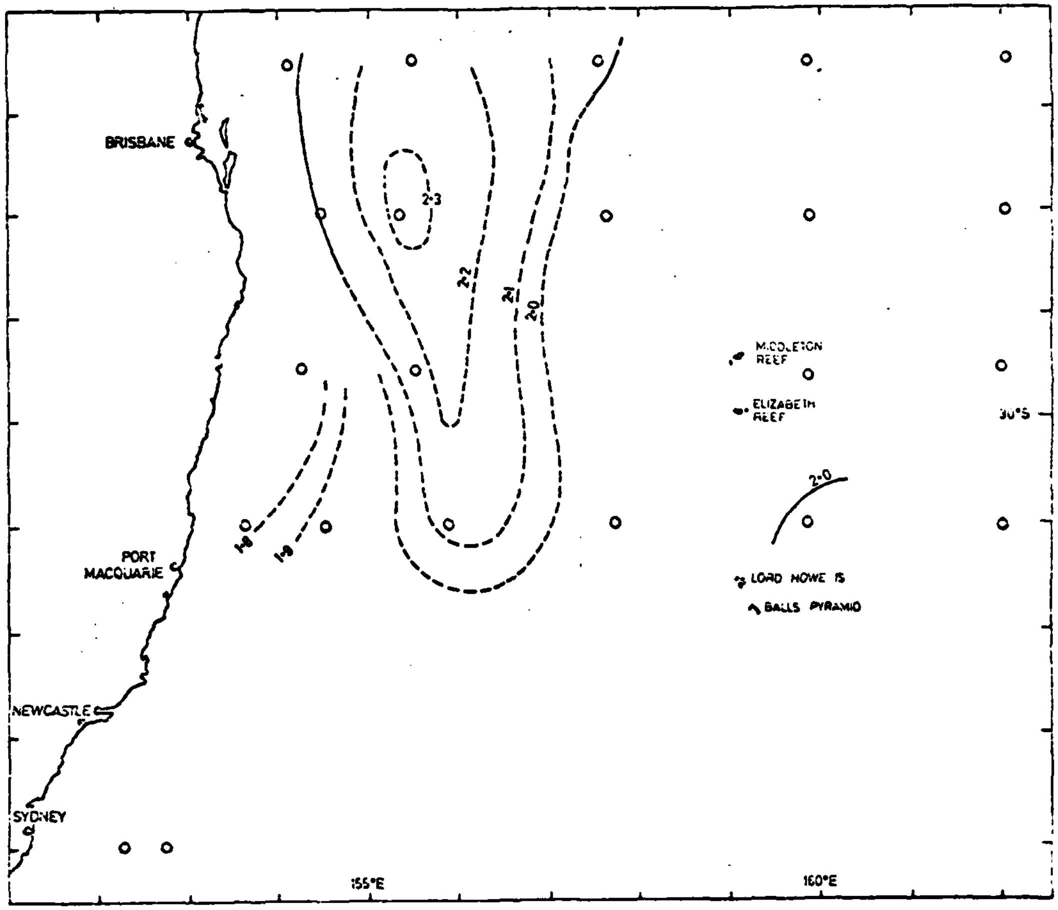


Fig. 54. Dynamic Height relative to 1300m. Cruise SP 11/78.

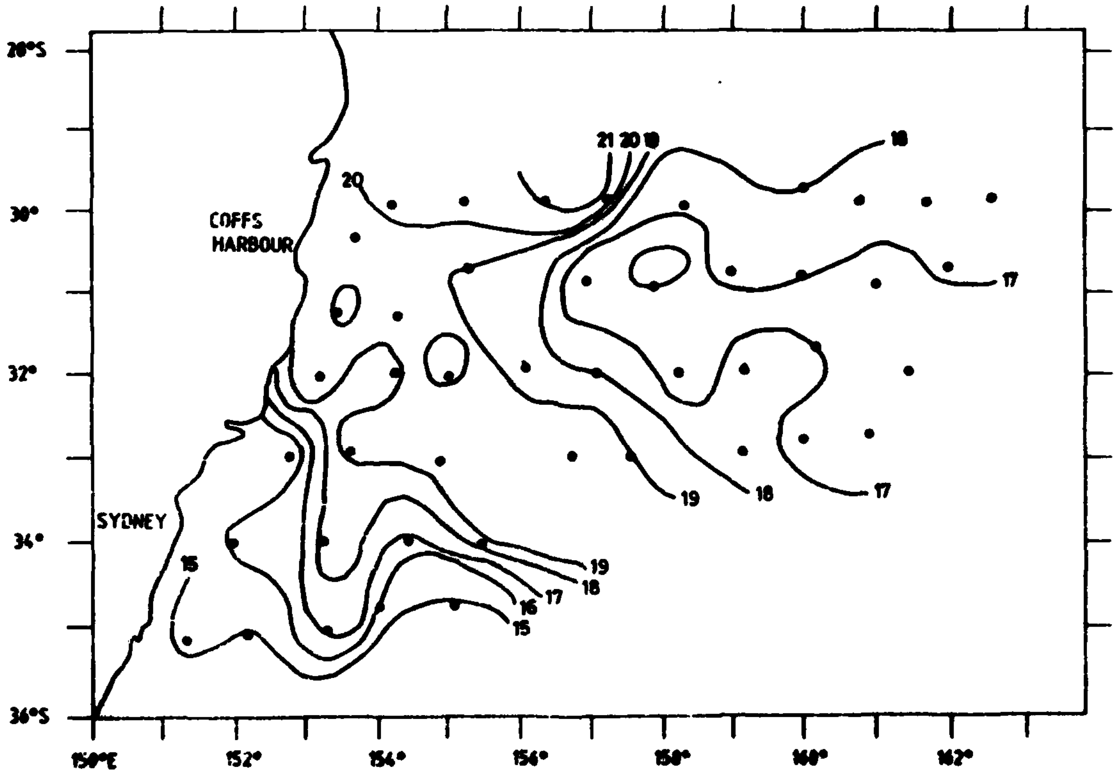


Fig. 55. Sea surface temperature HMAS Diamantina 1-11 Sep. 1978.

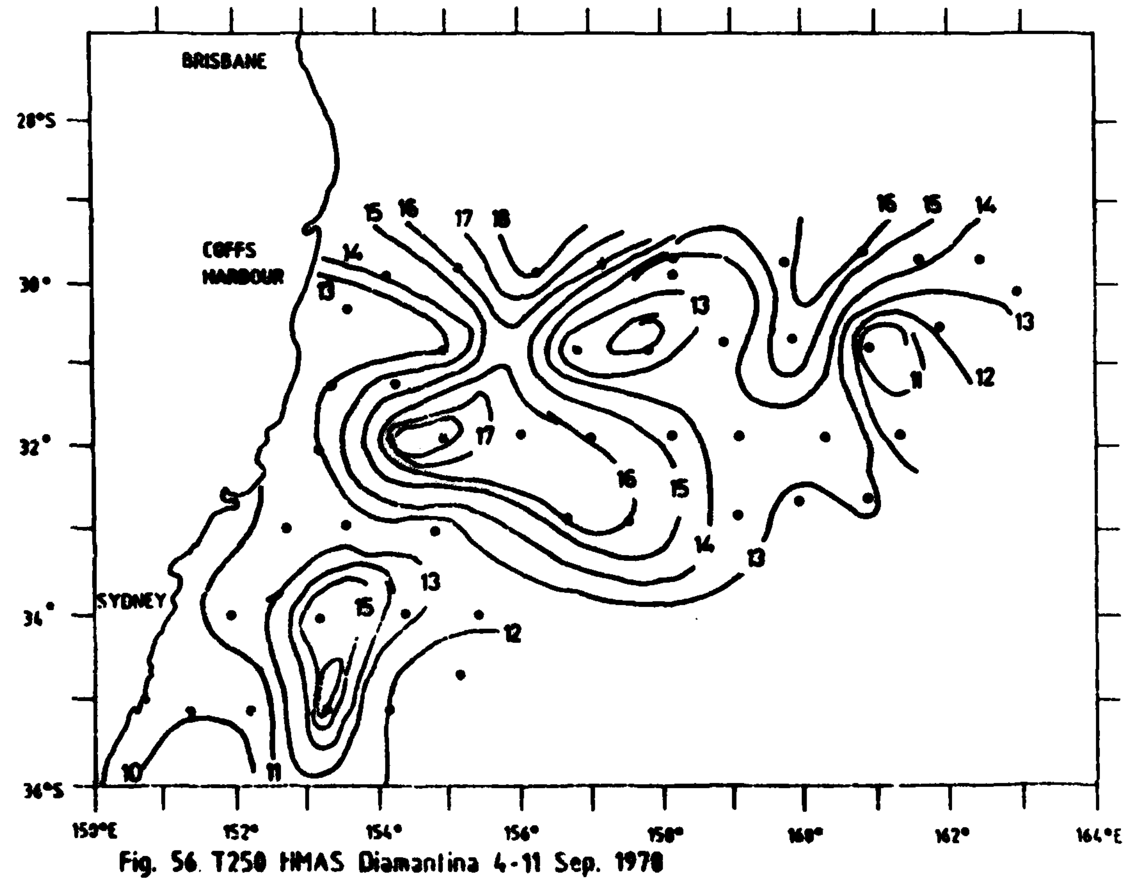


Fig. 56. T250 HMAS Diamantina 4-11 Sep. 1978

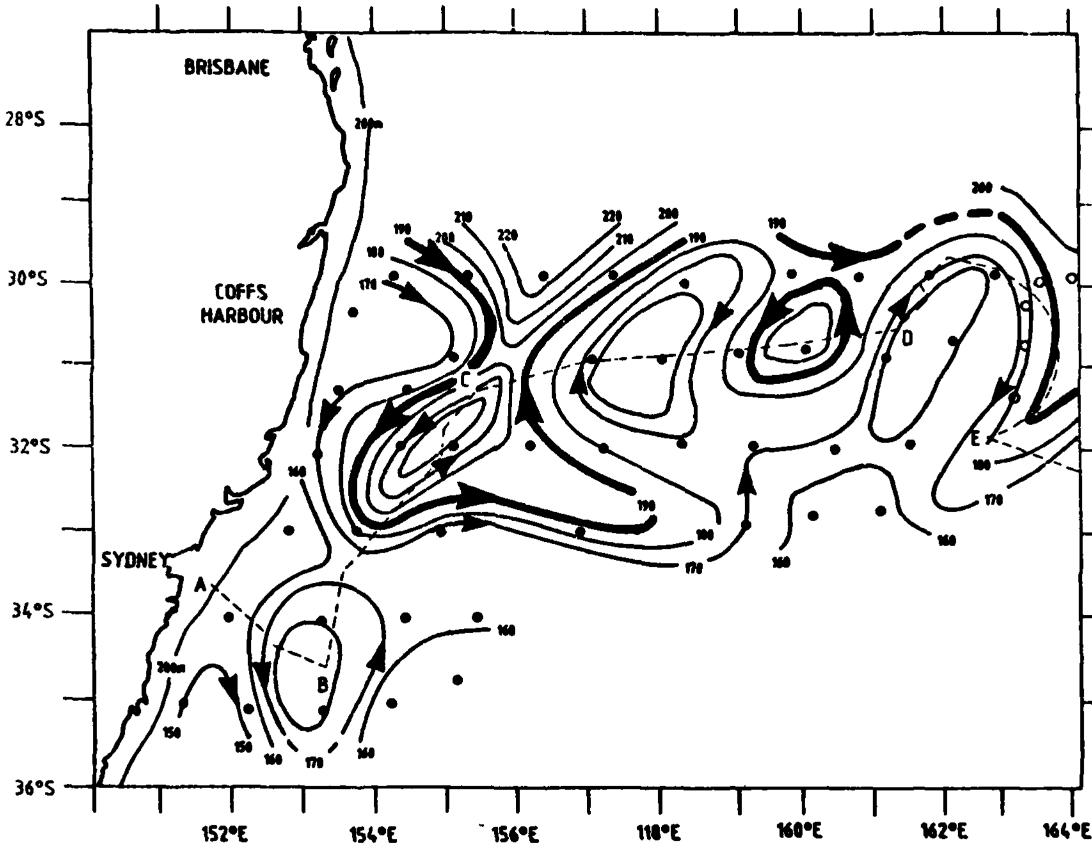


Fig. 57. Dynamic height anomaly (0 re 1300 dbar in dyn cm) from AXBT probes (29 Aug. 1978, filled circles), XBT probes along ABCDEF (HMAS Diamantina, 4-11 Sep. 1978), open circles (HMAS Diamantina, 13-18 Sep. 1978).

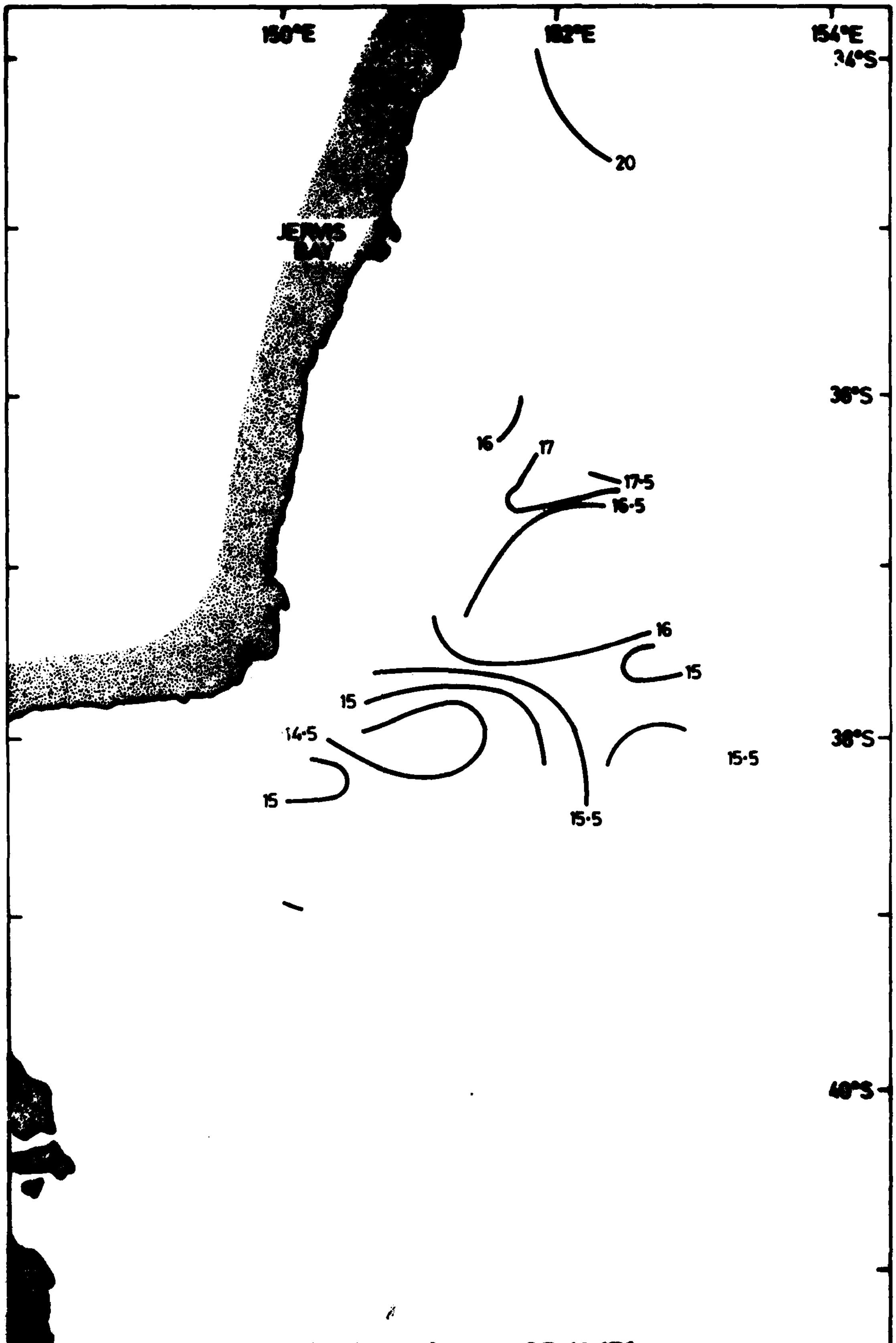


Fig.58. SST (°C). Cruise SP 12/78.
15–22 Sept. 1978.

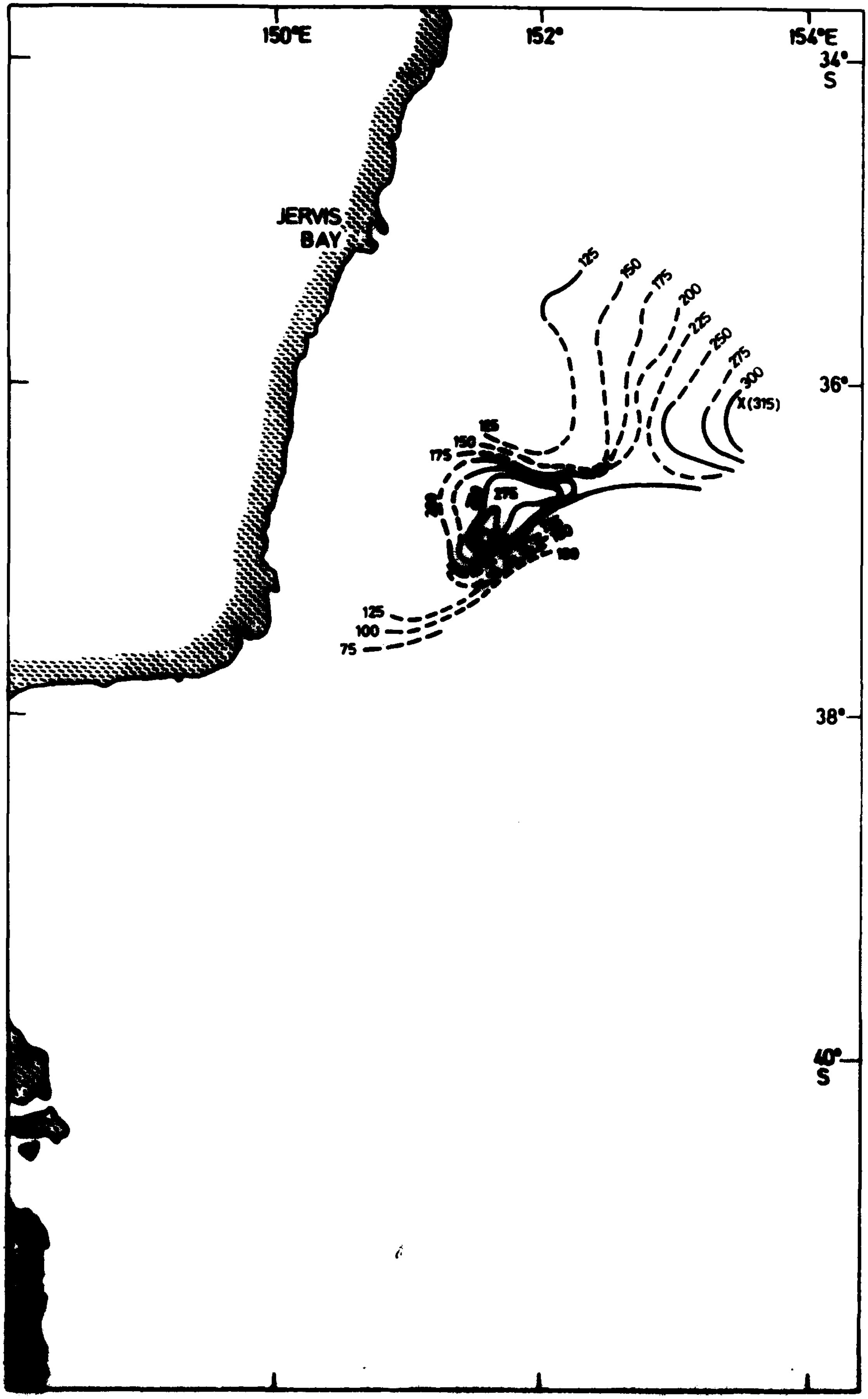


Fig.[illegible]. Cruise SP [illegible]. [illegible] Sept. [illegible].

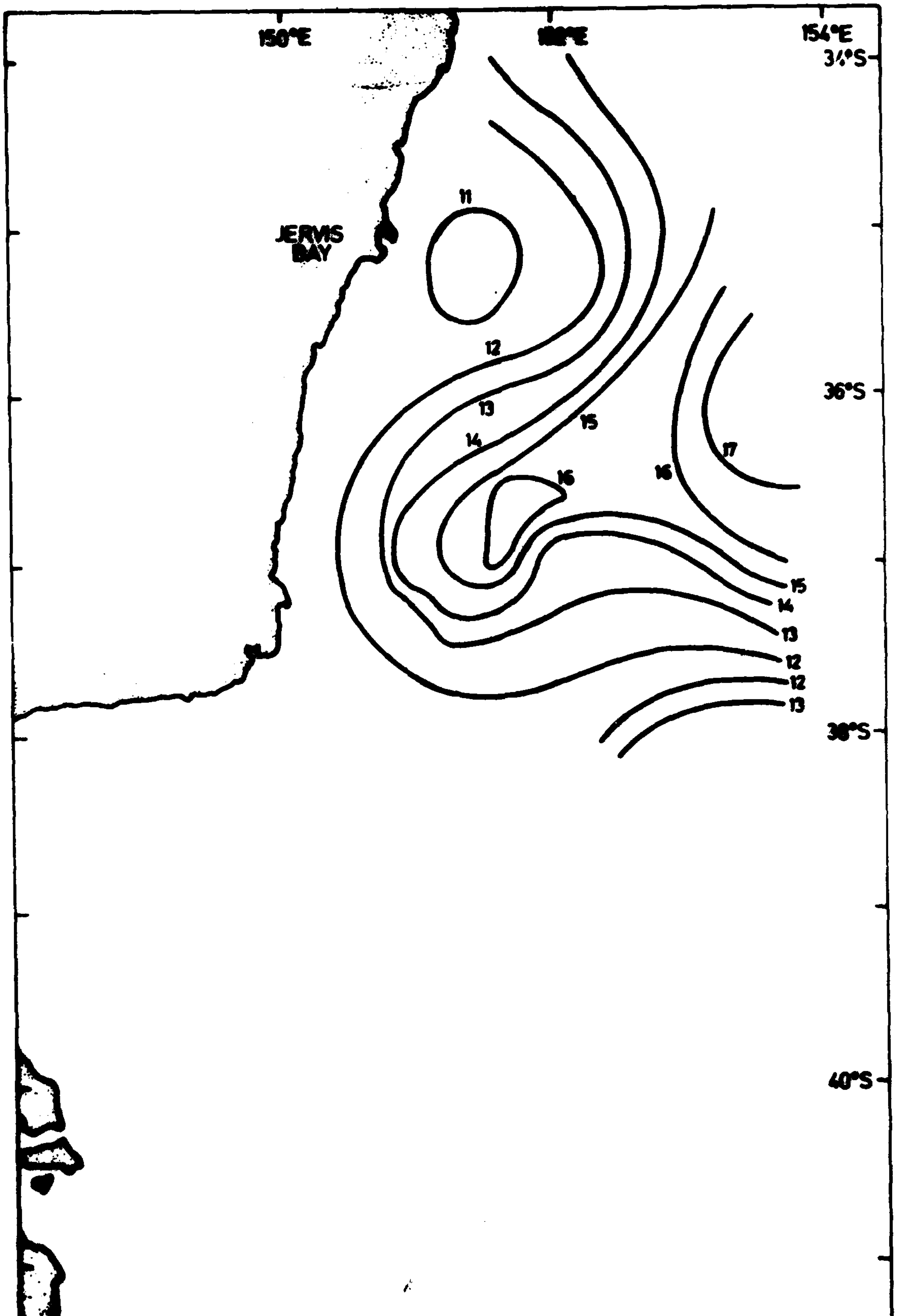


Fig. 60. $T_{250}$. Cruise SP 12/78.

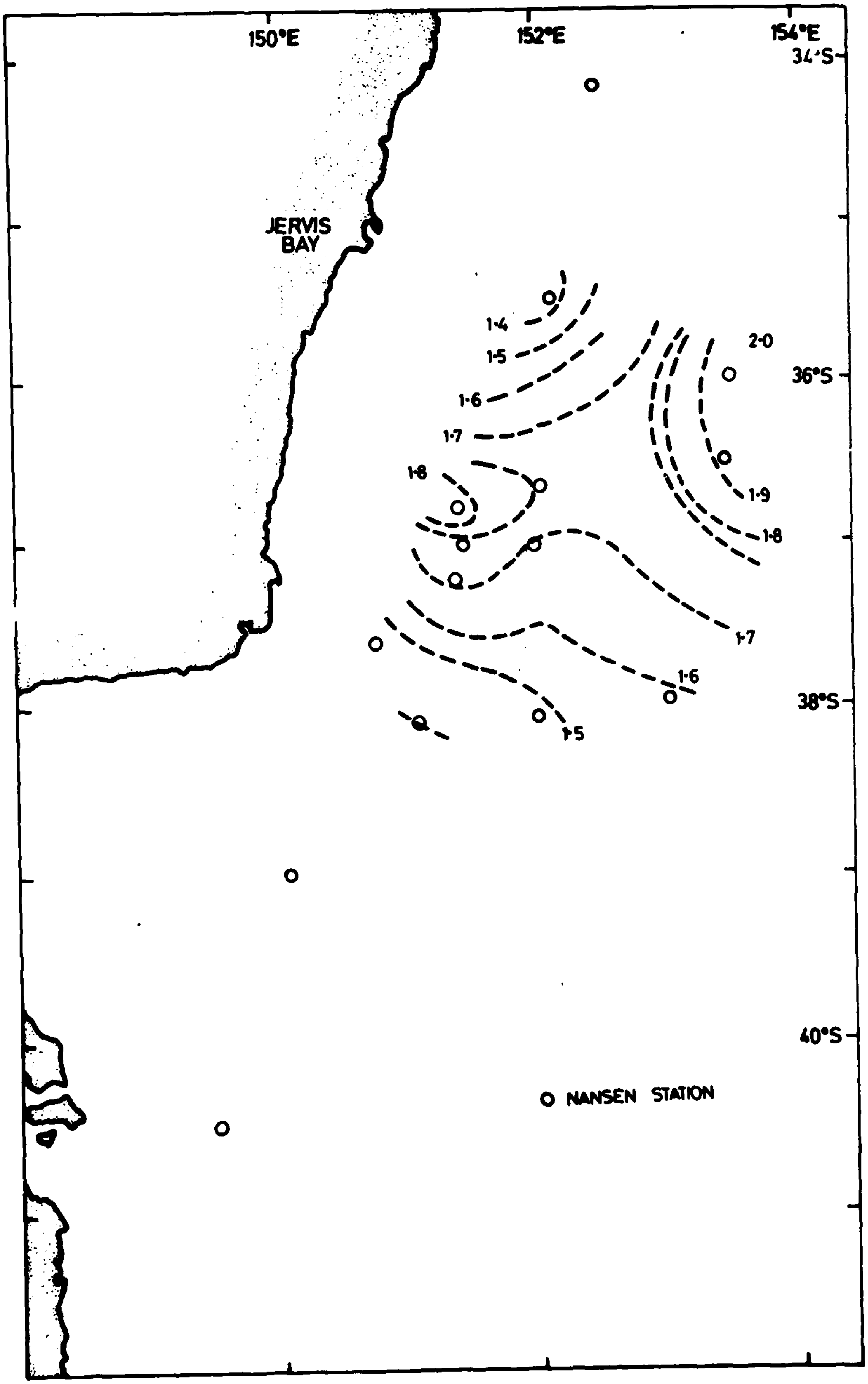


Fig.61. Dynamic Height relative to 1300m. Cruise SP 12/78.

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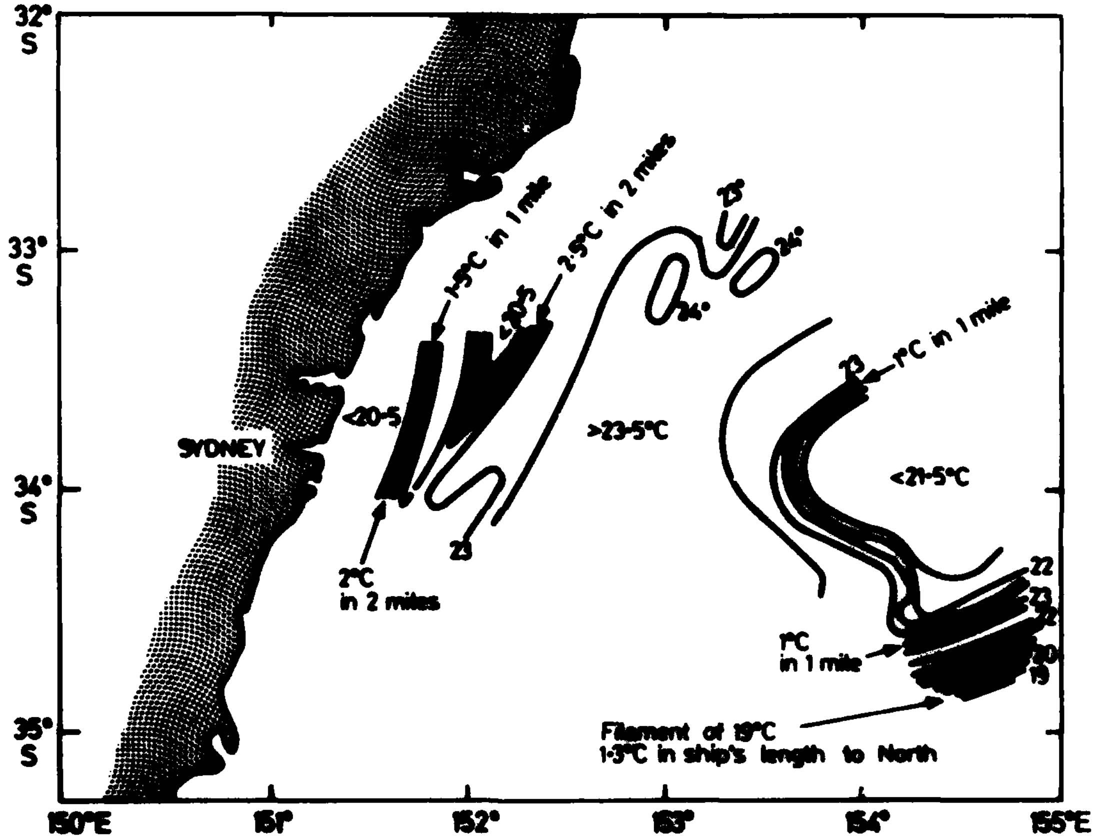


Fig.62. SST (°C). Cruise SP 17/78. 9 – 11 Dec. 1978.

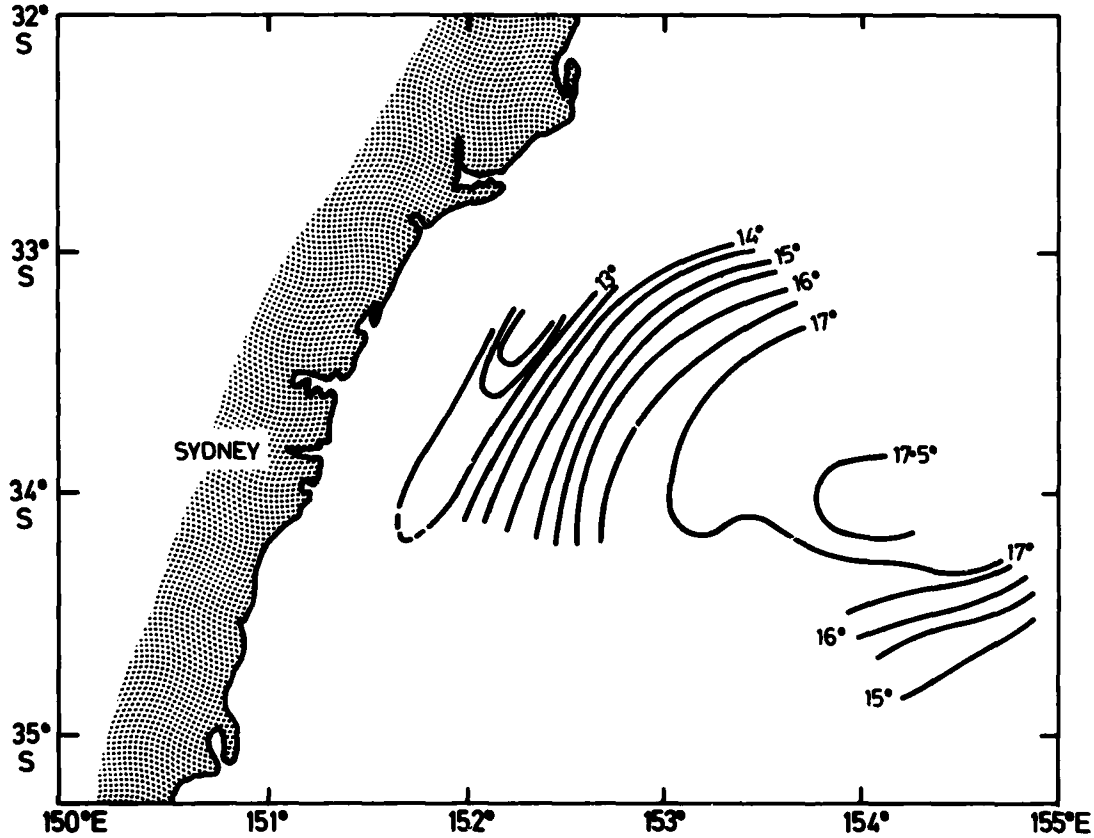


Fig.63. $T_{250}$ (°C). Cruise SP 17/78.

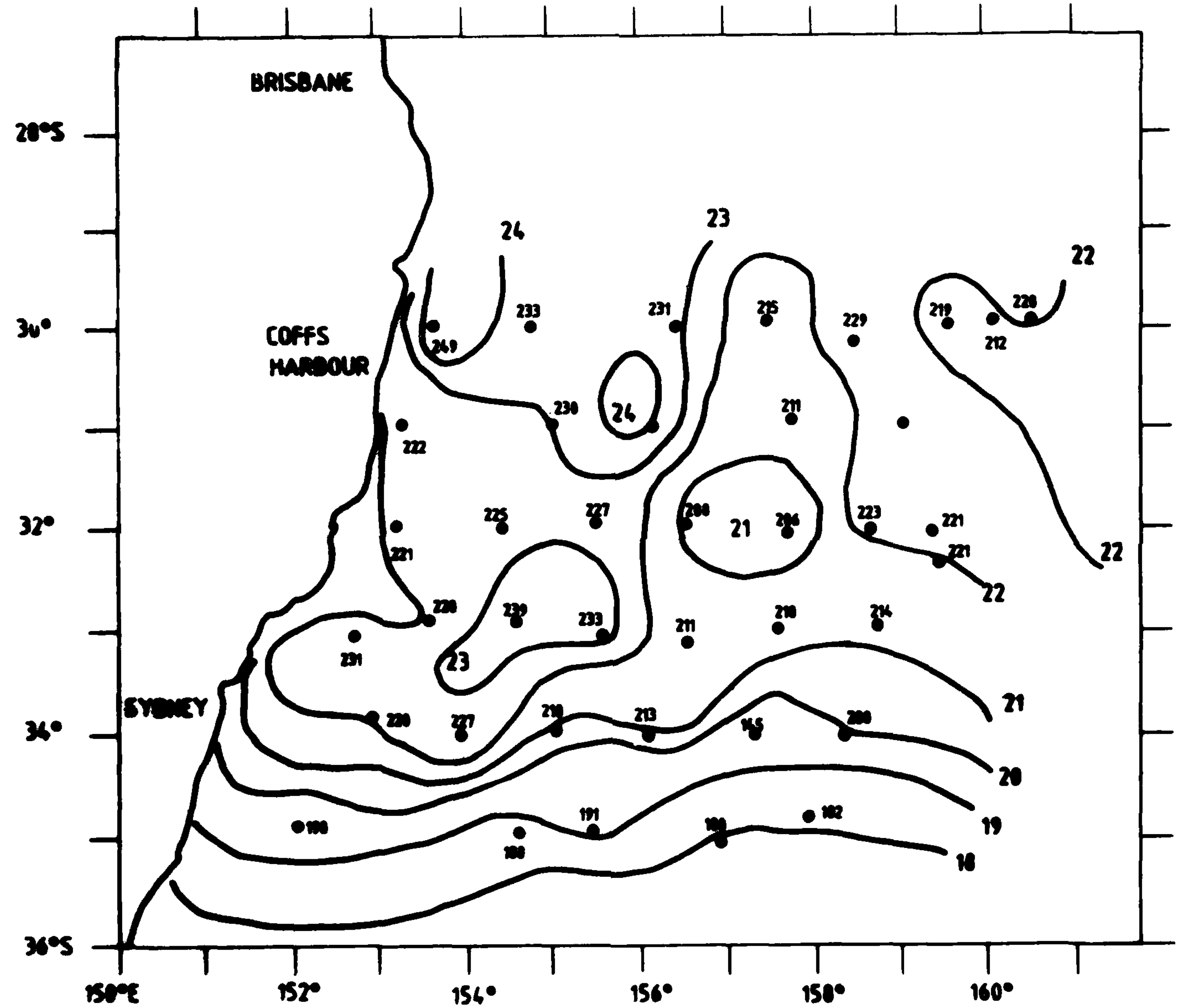


Fig. 64. Sea surface temperature (°C) AXBT survey 13 Dec. 1978.

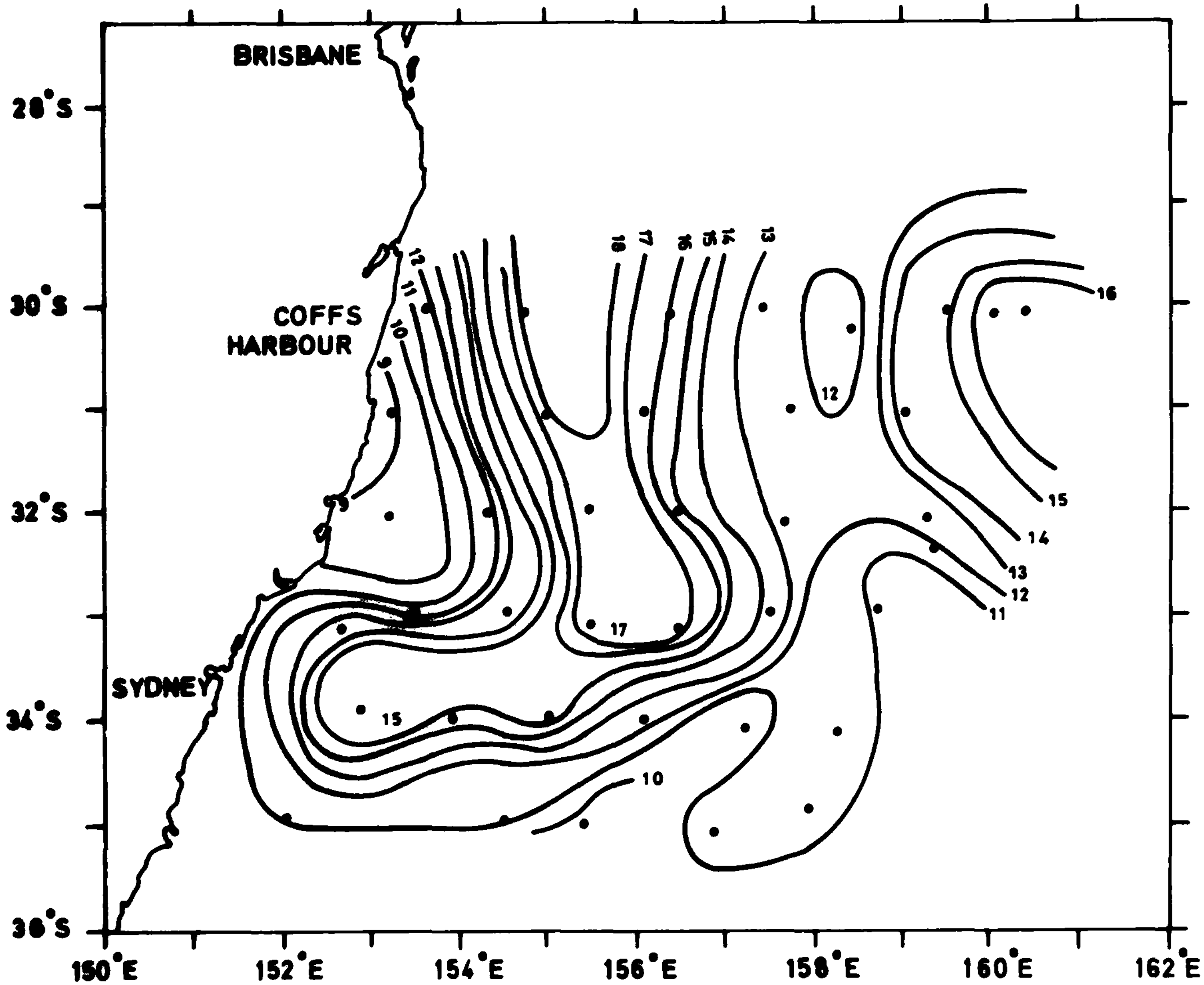


Fig. 65. T250 AXBT Survey 13 Dec. 1978.

DEC

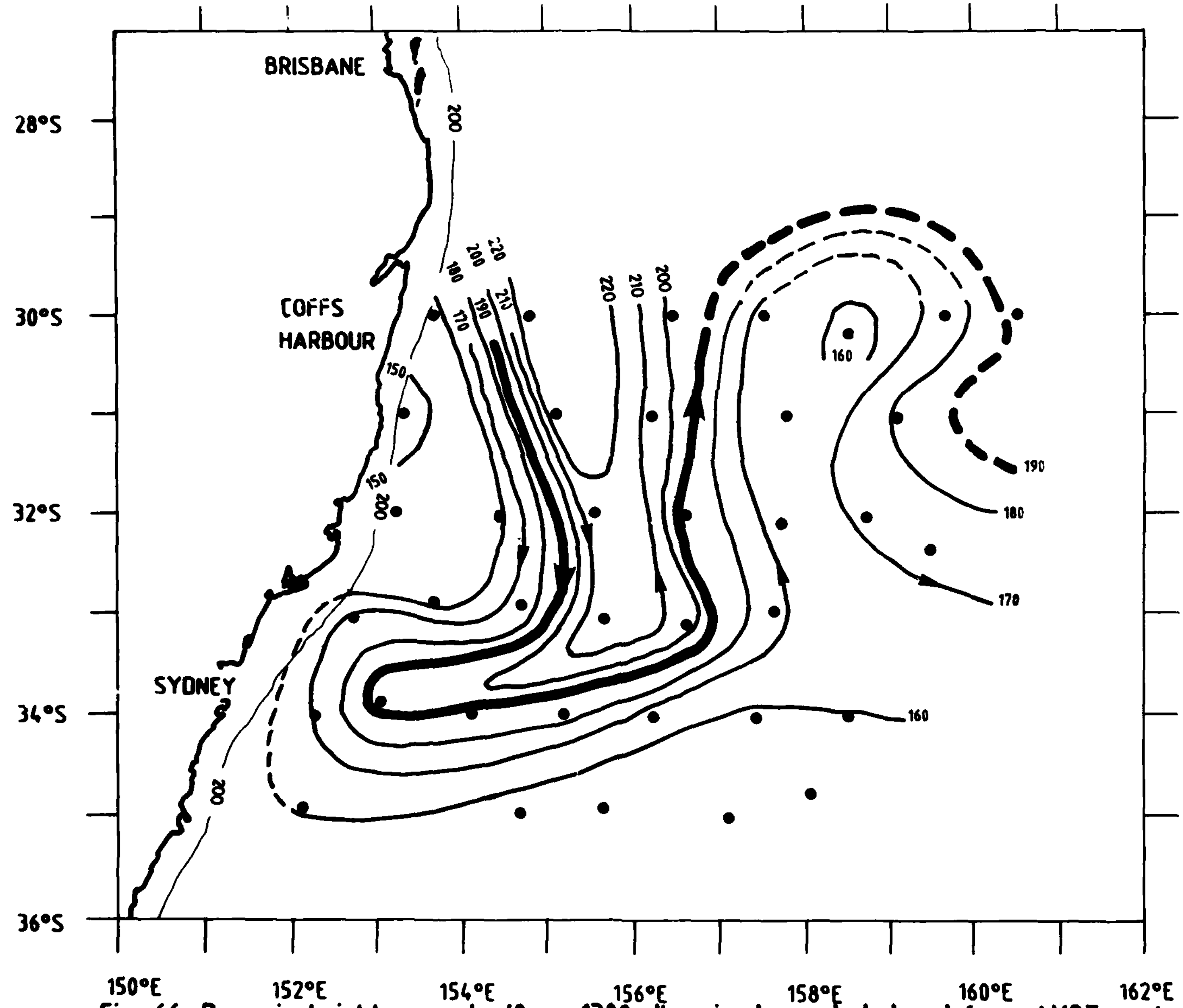


Fig. 66. Dynamic height anomaly (0 re 1300 dbar in dyn cm) deduced from AXBT probes (13 Dec. 1978, filled circles).

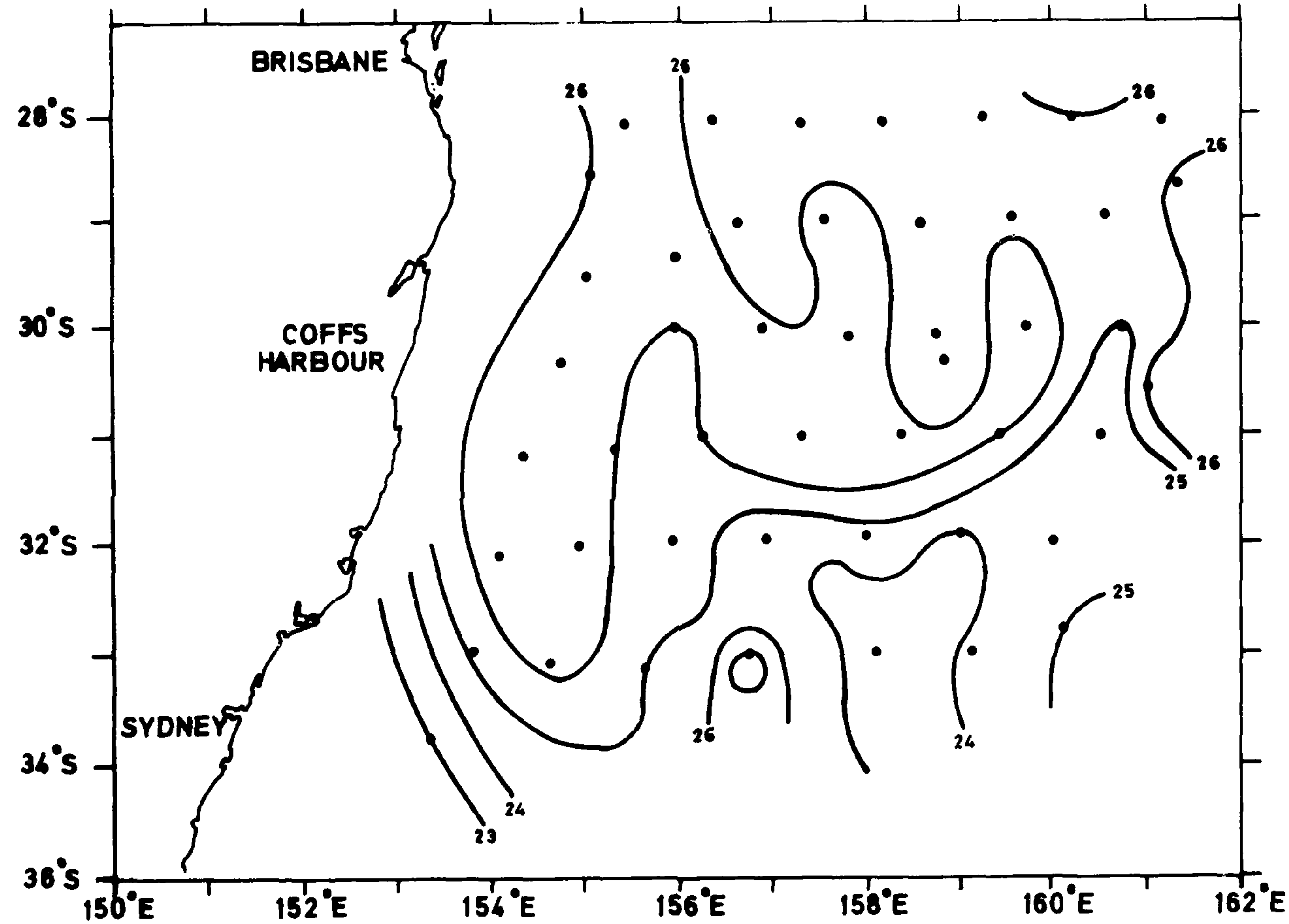


Fig. 67. S.S.T. (°C) H.M.A.S. Kimbla 11-19 Feb. 1979

DEC.

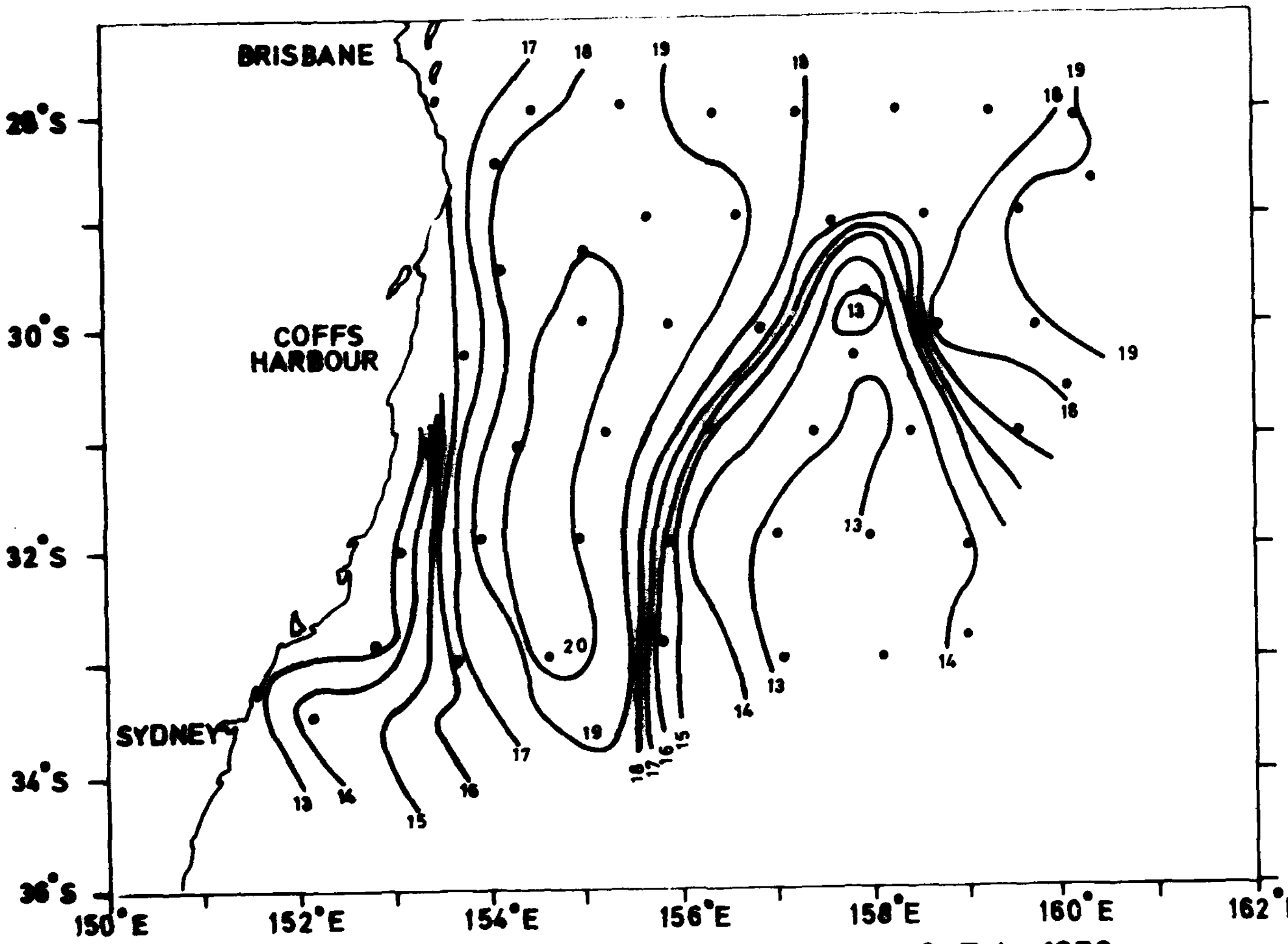


Fig. 68. T250 H.M.A.S Kimbla 11-19 Feb. 1979.

DEC 81

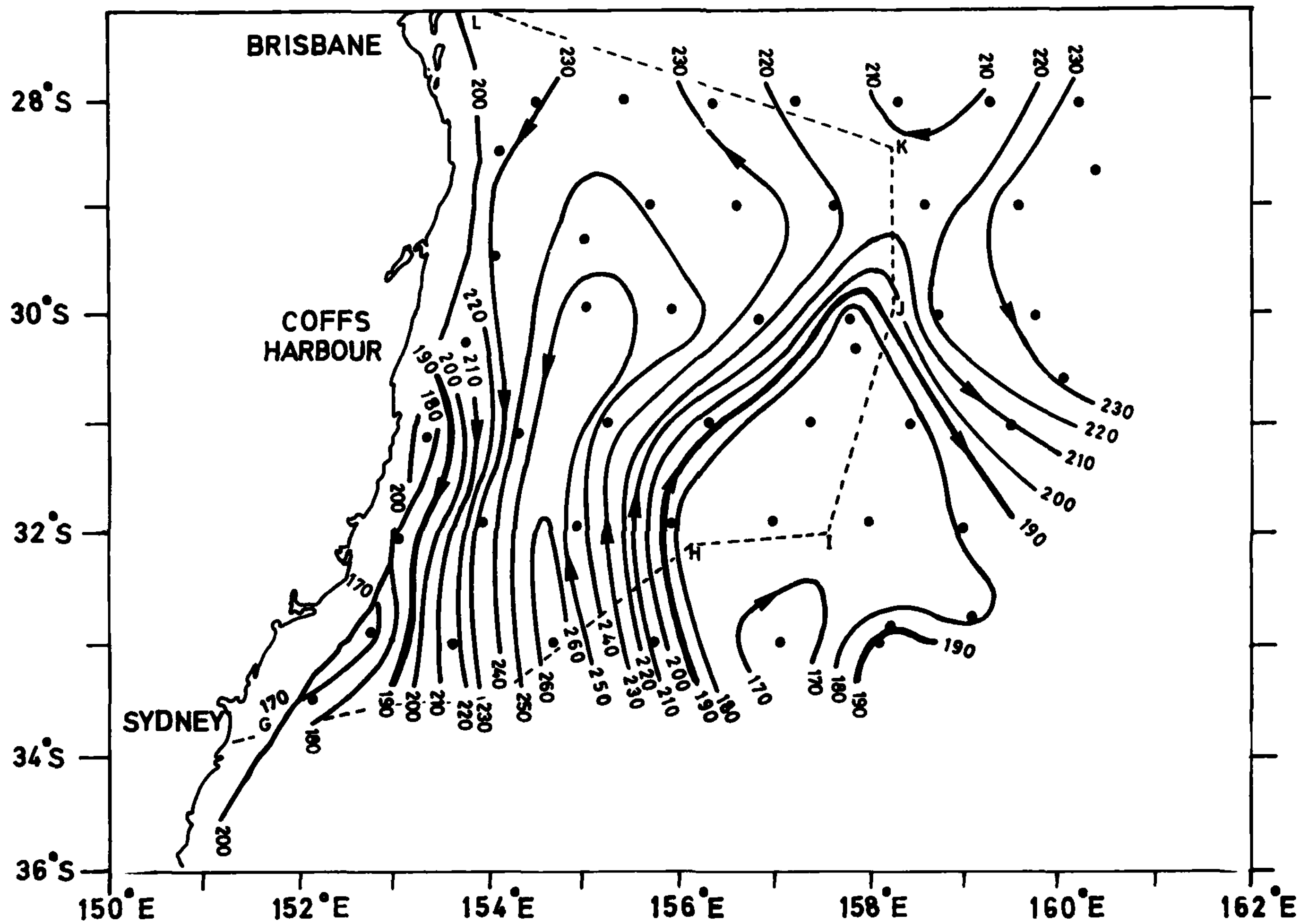


Fig.69. Dynamic height anomaly ( 0 re 1300 dbar in dyn cm) deduced from AXBT probes (8 Feb. 1979, filled circles) and XBT probes along GHIJKL ( HMAS Kimbla, 11 to 19 Feb. 1979).

DEC

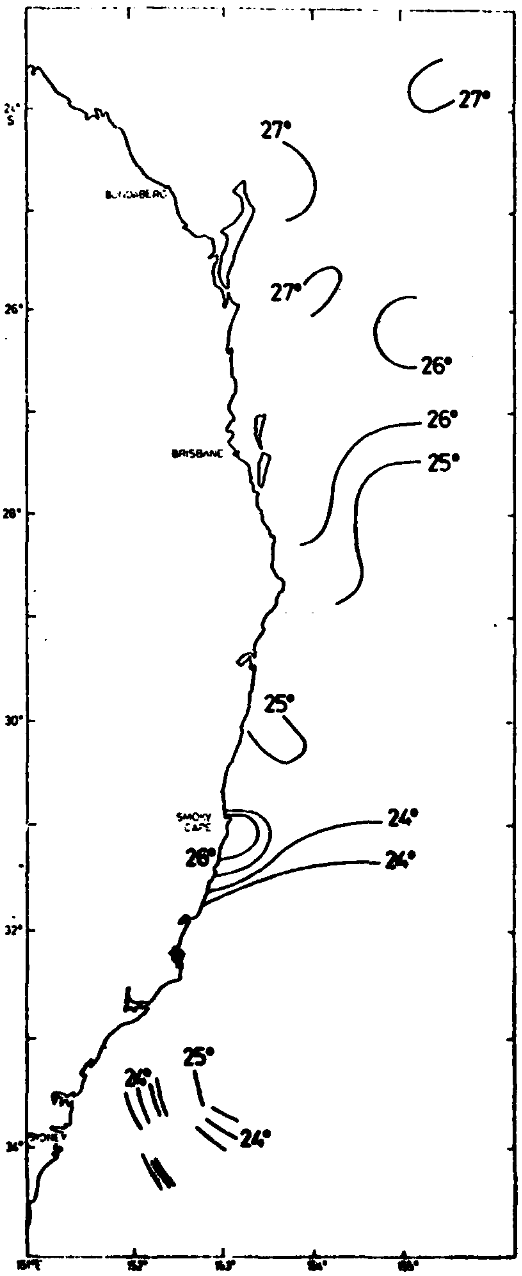


Fig.70. SST(°C). Cruise SP3/79. 18–28 March 1979.

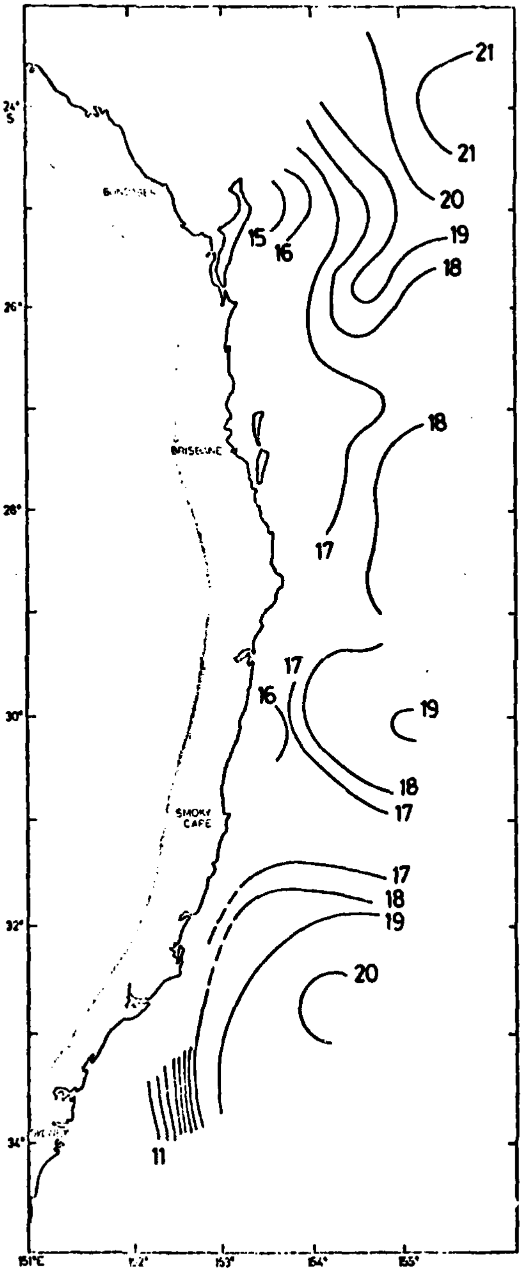


Fig. 71. $T_{250}$ (°C). Cruise SP 3/79.

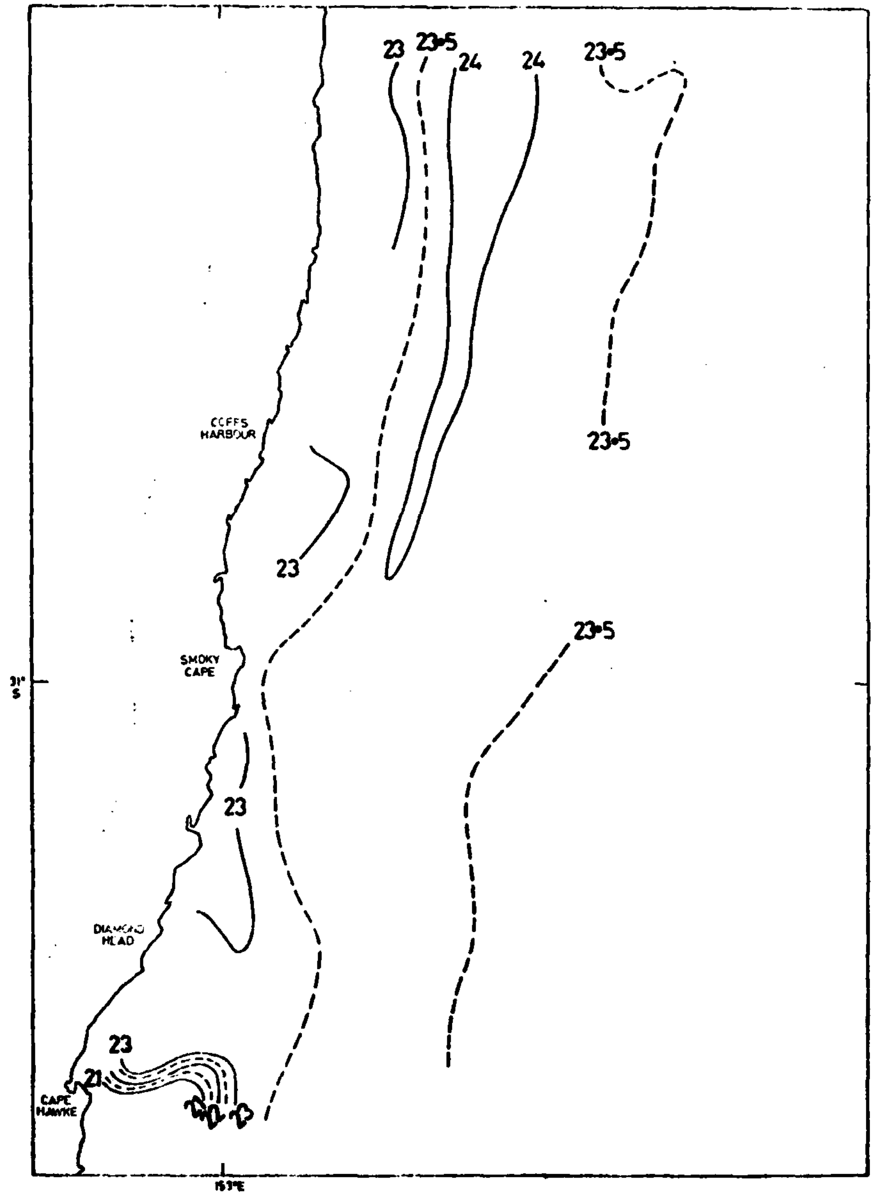


Fig. 72. SST (°C). Cruise SP6/79. (Part 1). 10–22 May 1979.

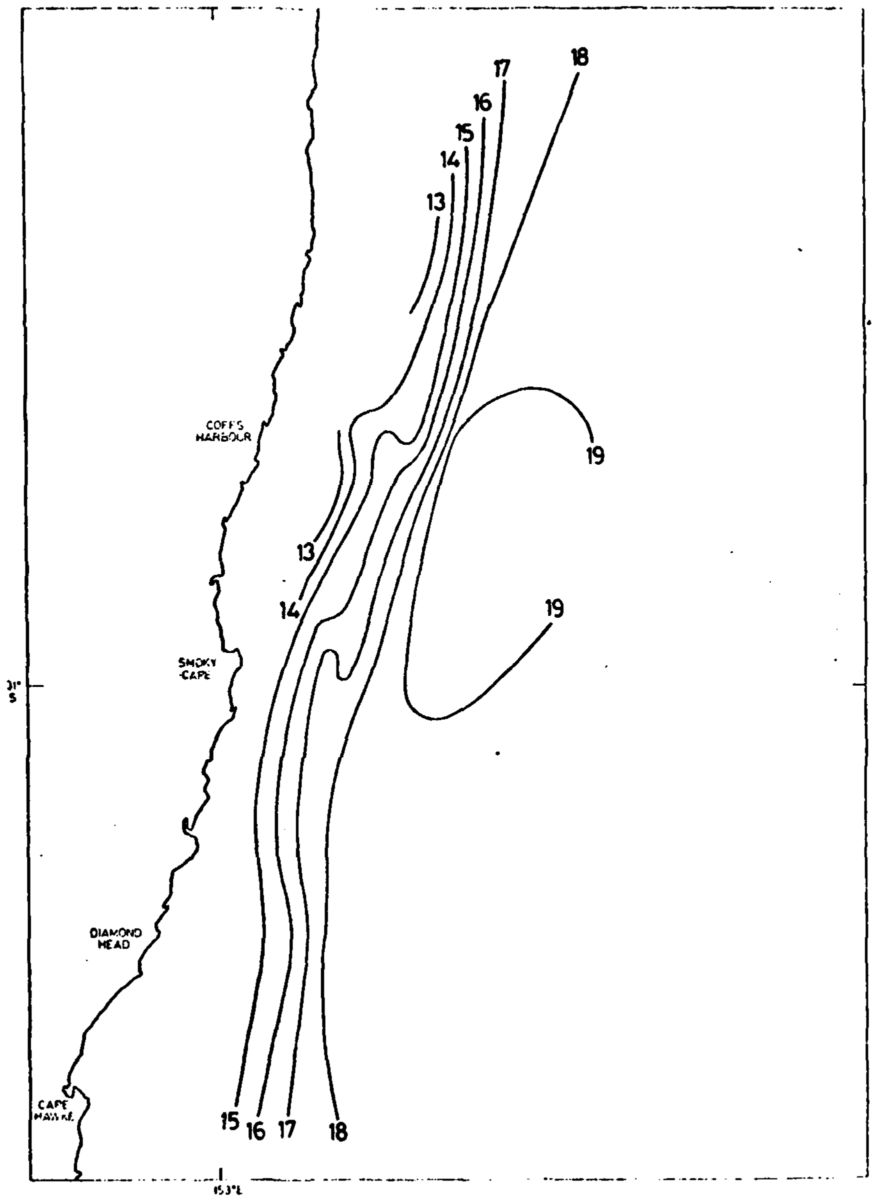


Fig.73. $T_{250}$(°C). Cruise SP 6/79. (Part 1).

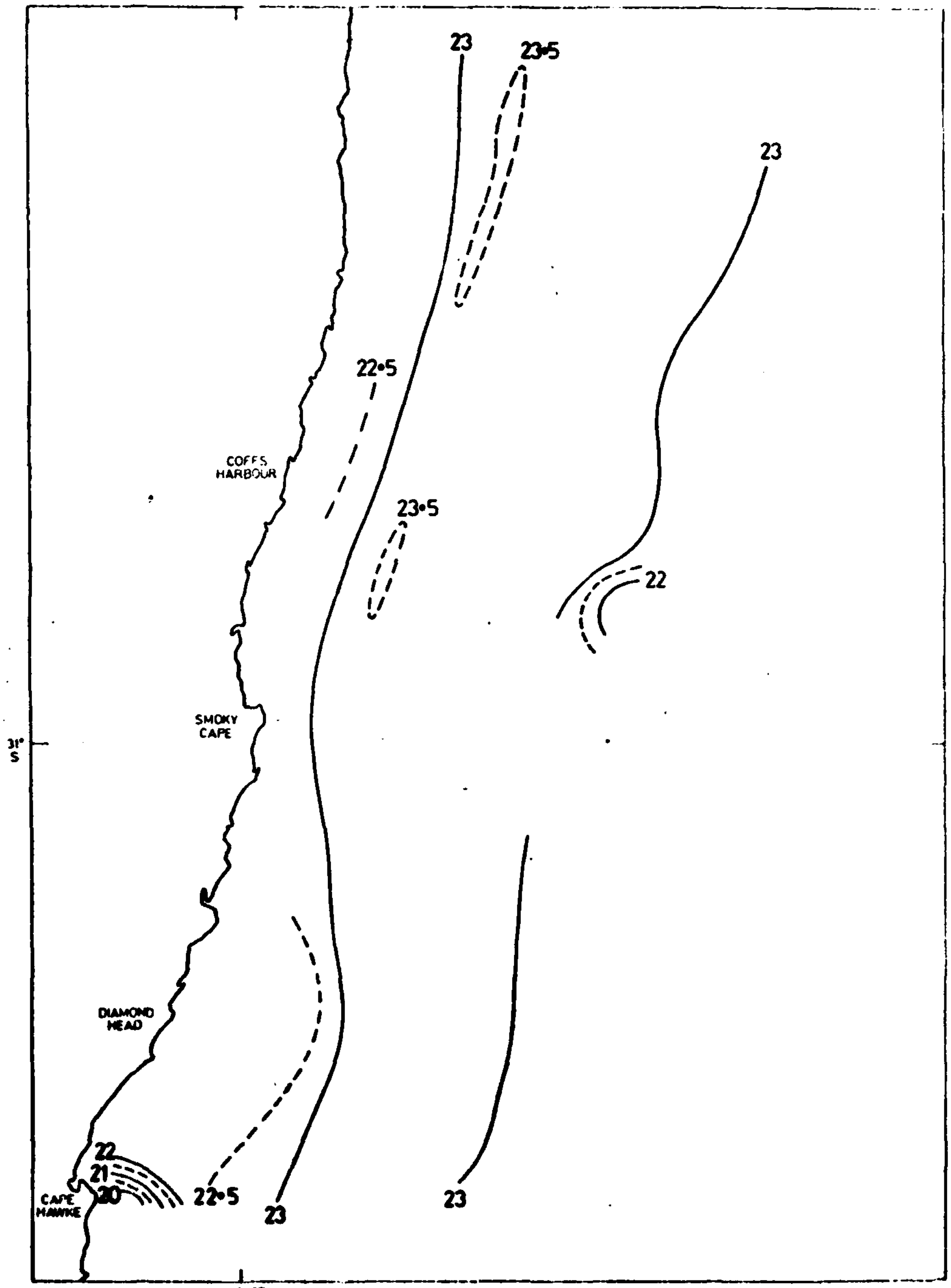


Fig. 74. SST(°C). Cruise SP6/79. (Part 2).

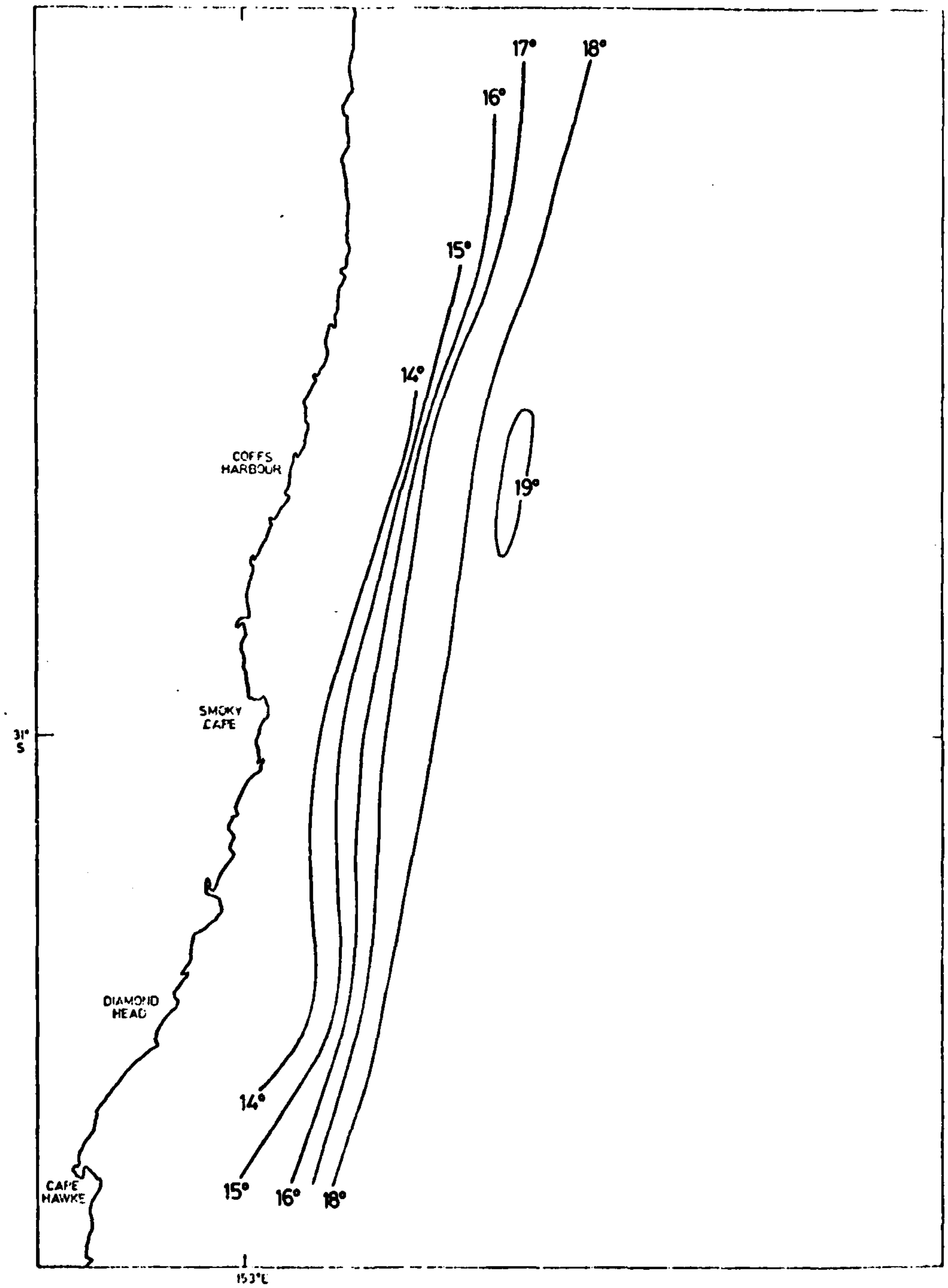


Fig.75. $T_{250}$ (°C). Cruise SP 6/79. (Part 2).

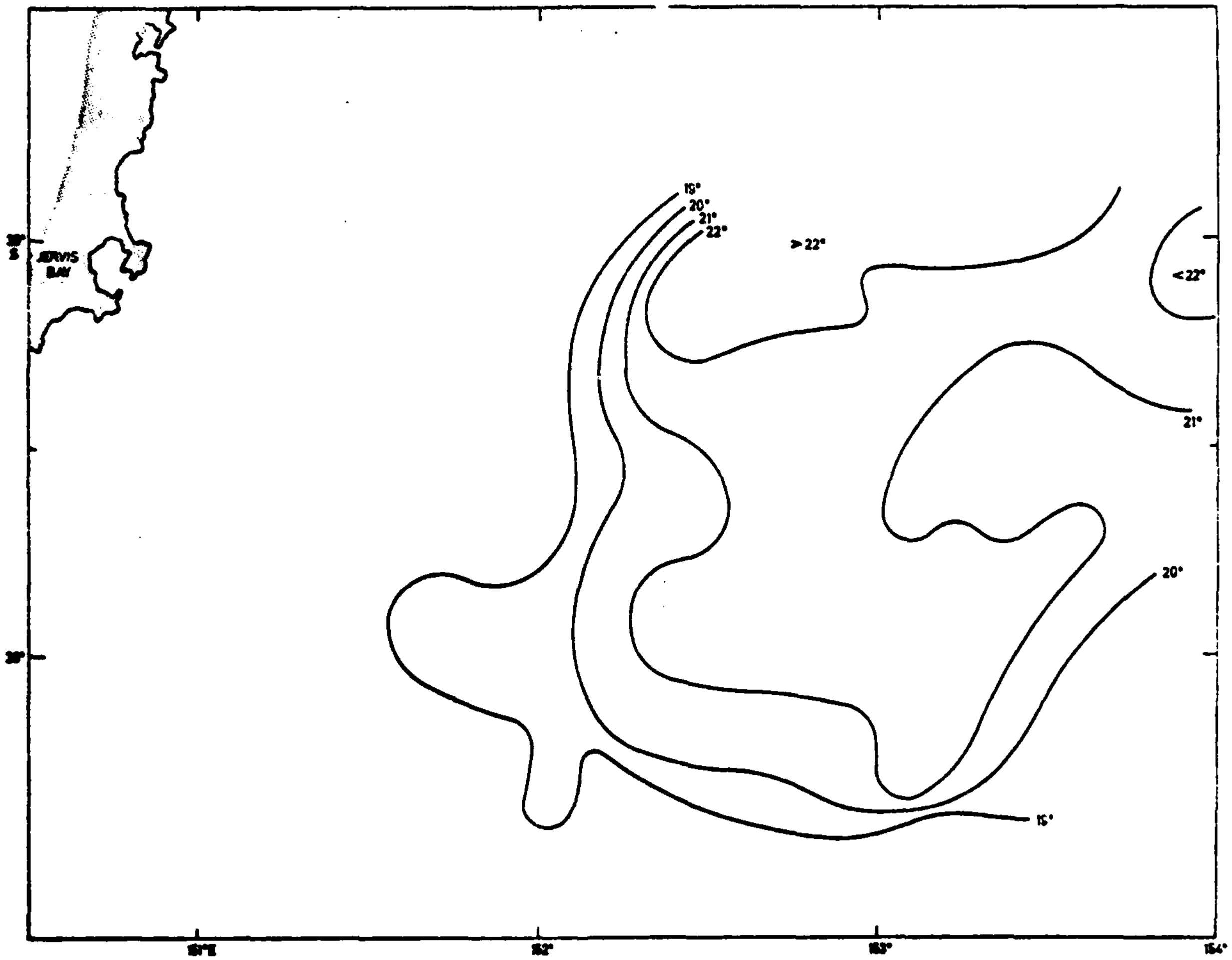


Fig. 76. SST (°C). Cruise SP 7/79 (1st survey). 23 May – 6 June 1979.

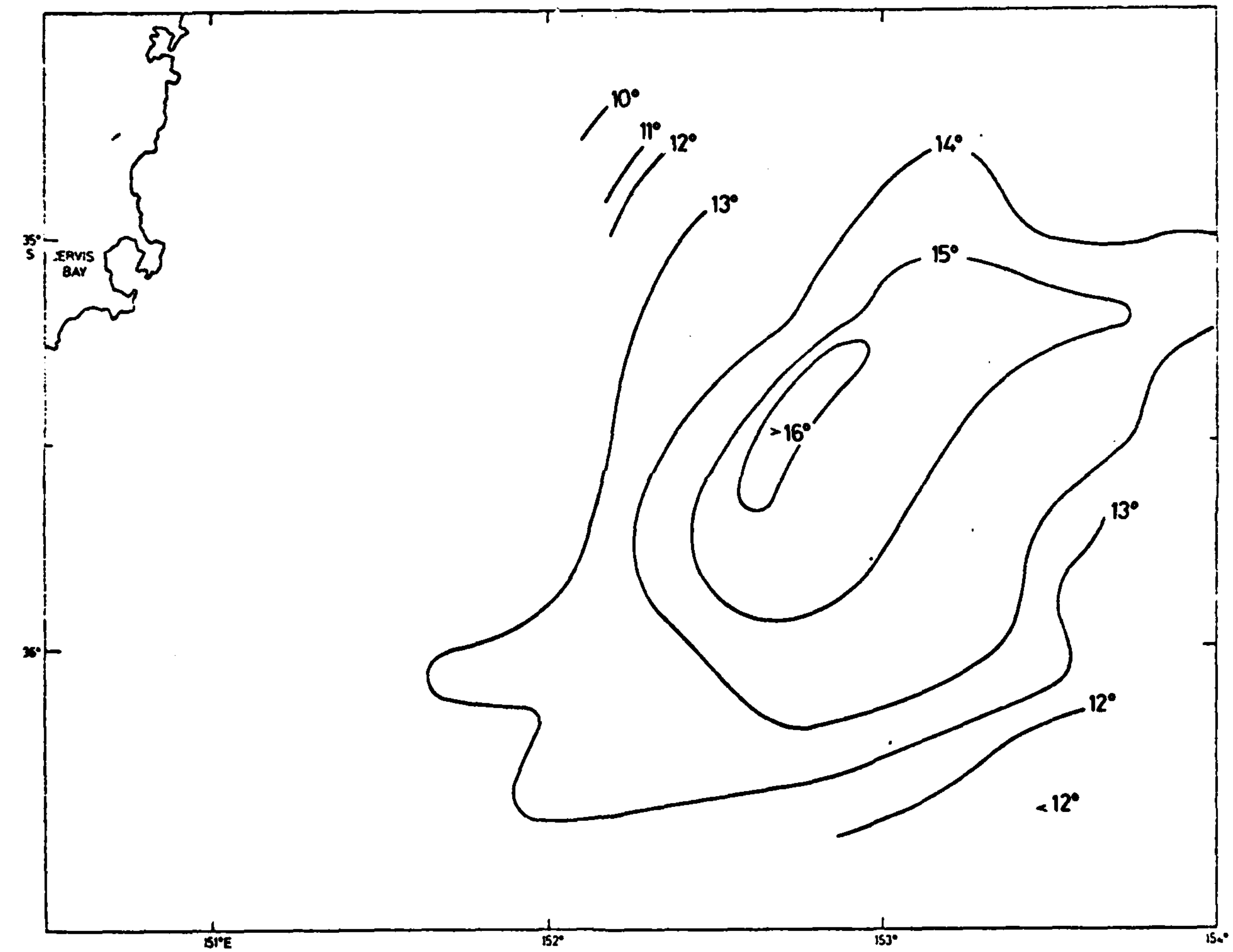


Fig. 77. $T_{250}$ (°C). Cruise SP7/79 (1st survey).

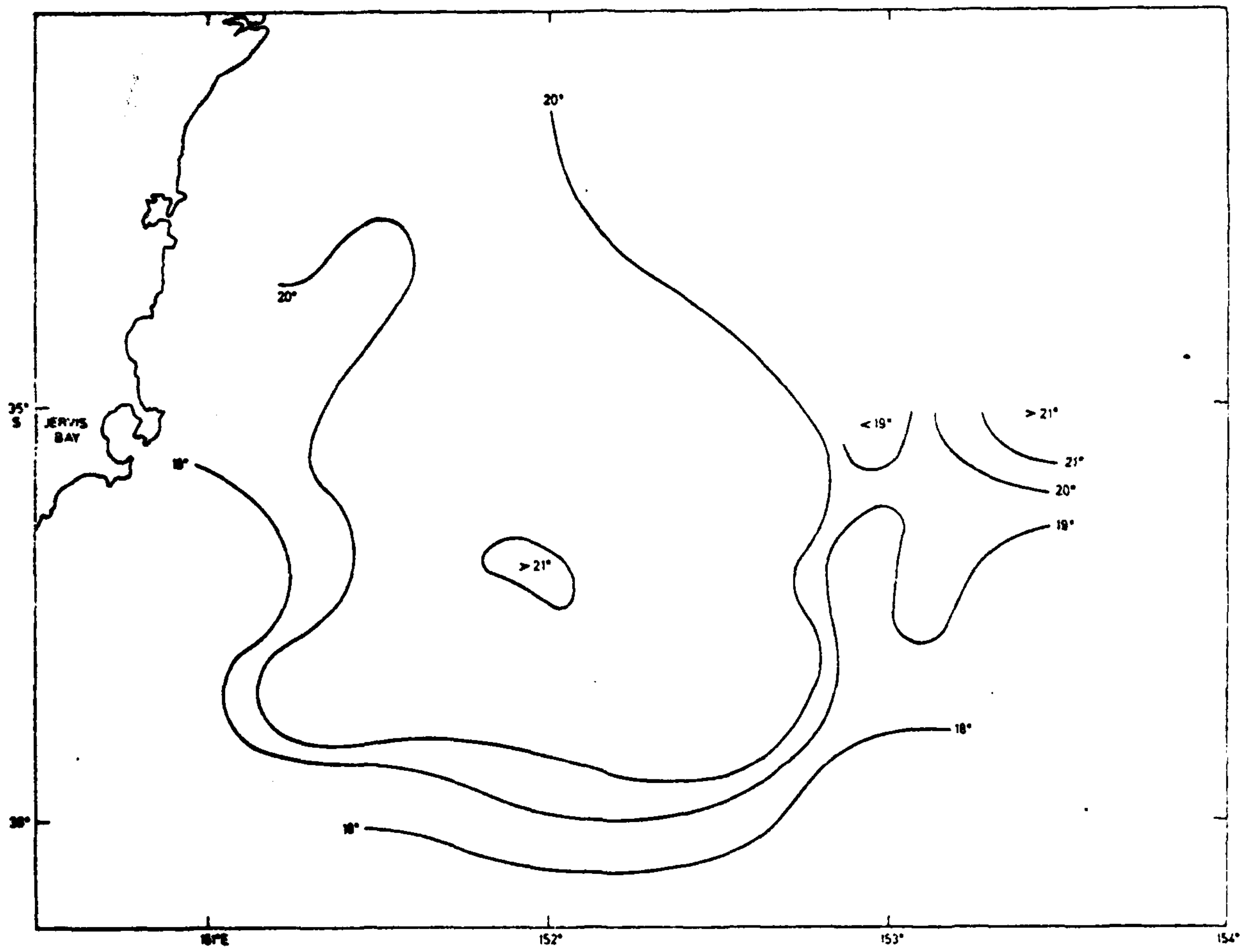


Fig. 78. SST (°C). Cruise SP 7/79. (2nd survey).

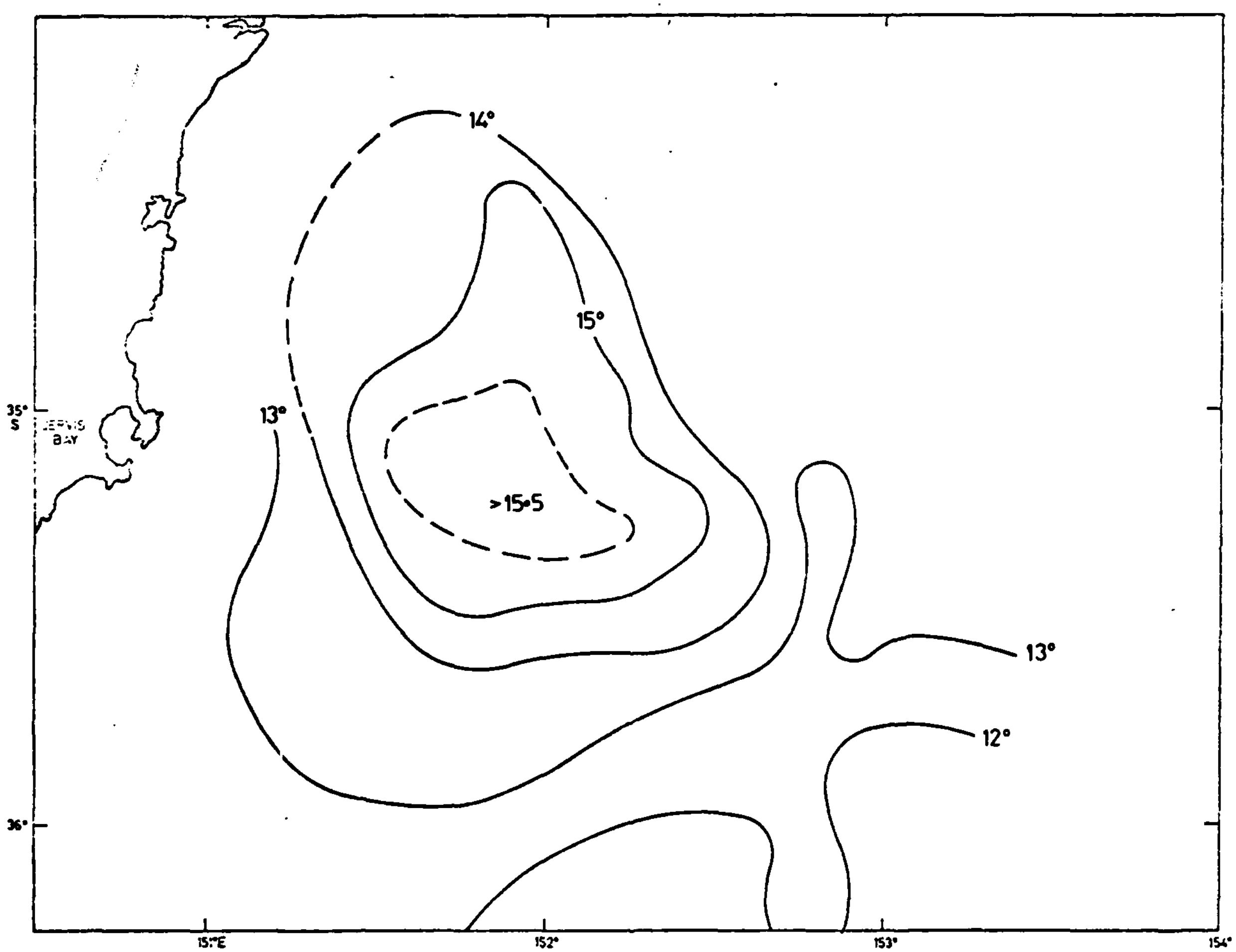


Fig.79. $T_{250}$ (°C). Cruise SP 7/79. (2nd survey).

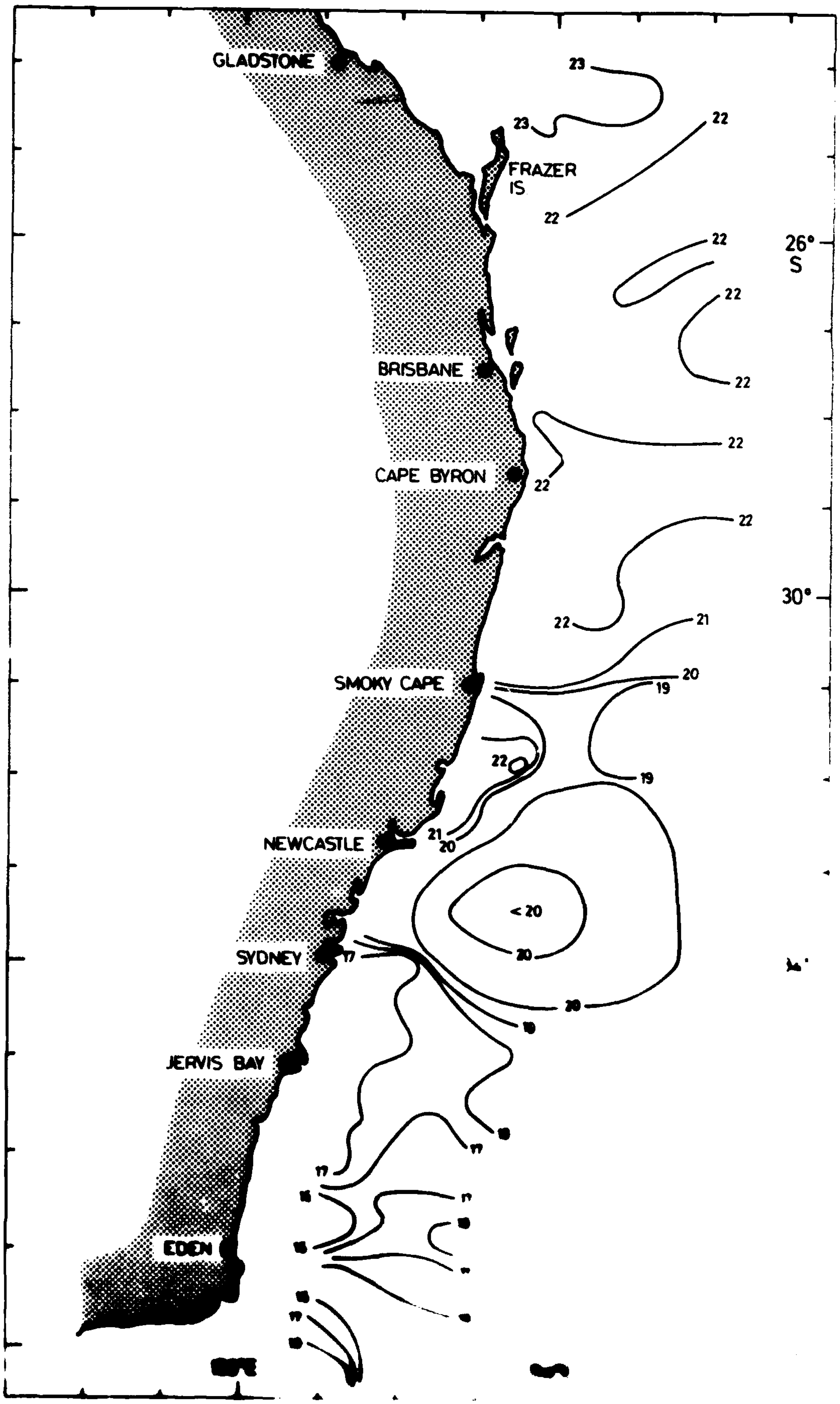


Fig.80 SST (°C) Cruise [illegible]

AD-A122 112 COMPARISONS BETWEEN PATTERNS OF SEA-SURFACE TEMPERATURE AND SUB-SURFACE P..(U) ROYAL AUSTRALIAN NAVY RESEARCH LAB EDGECLIFF P J MULHEARN ET AL. JUL 82 2/2

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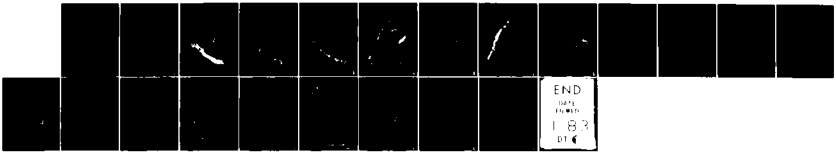

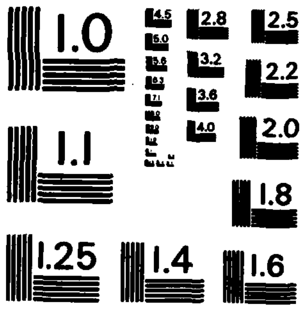


MICROCOPY RESOLUTION TEST CHART
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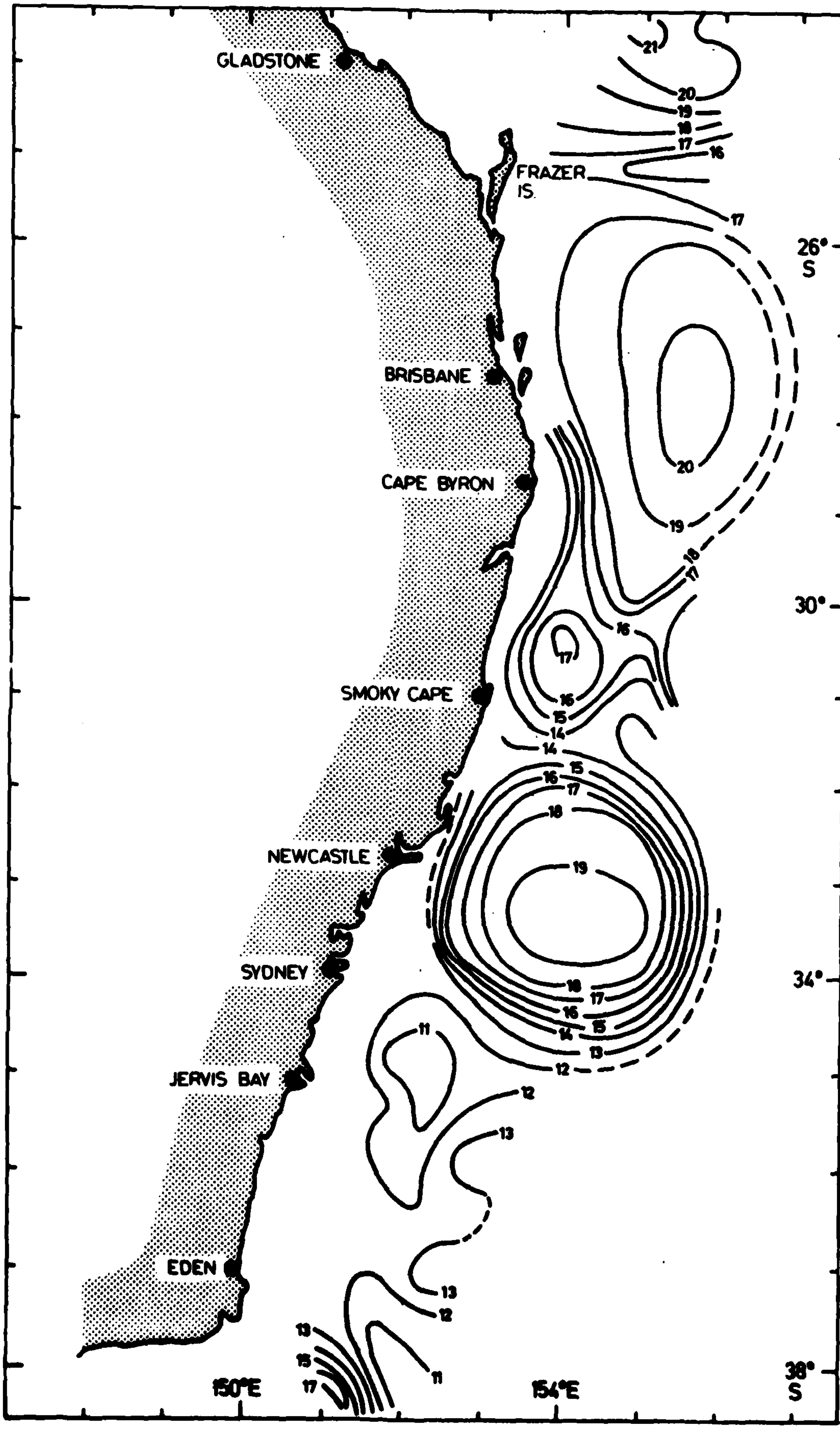


Fig. 81. $T_{250}$ (°C). Cruise SP 8/79.

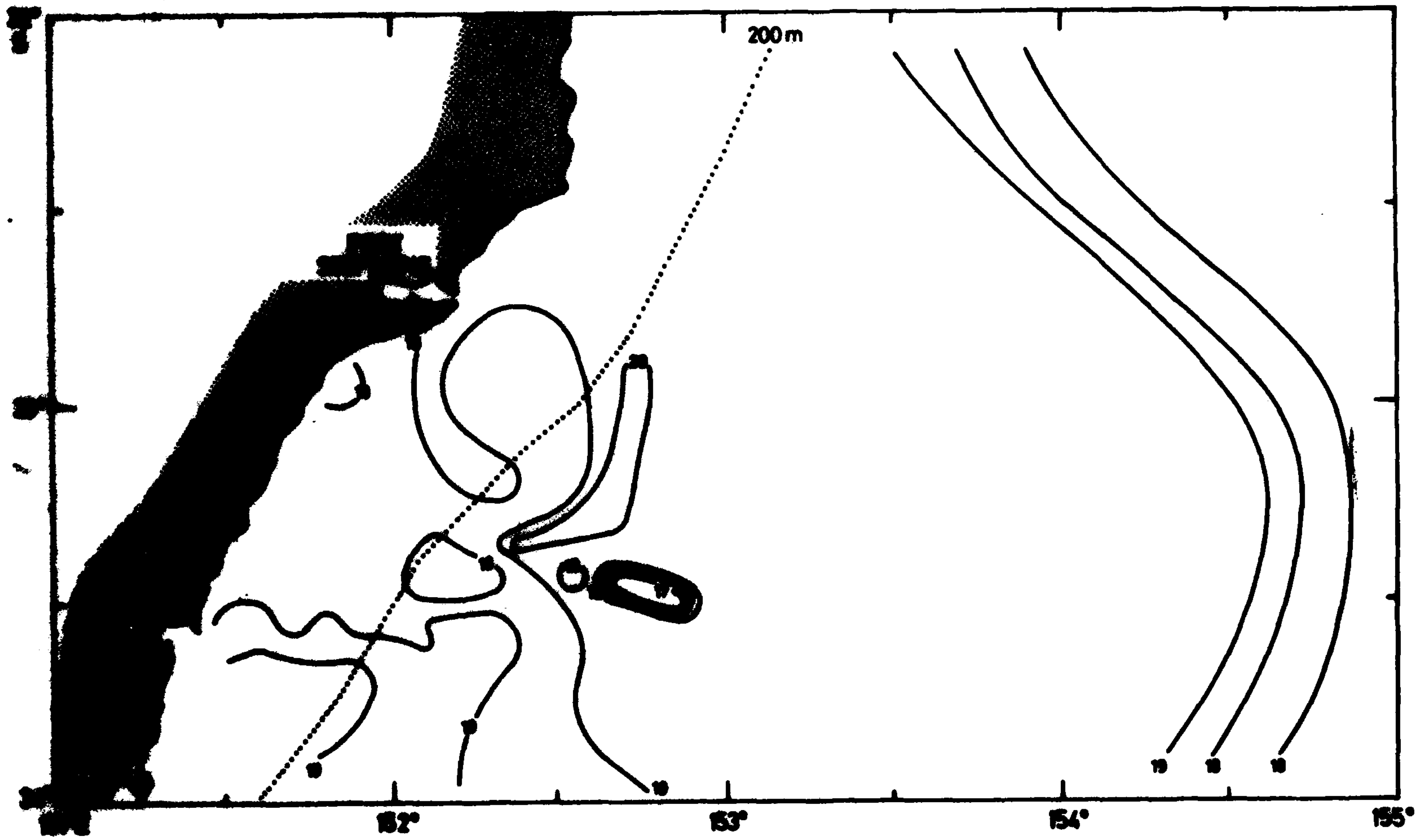


Fig. 82. SST (°C). Cruise SP 9/79. 17–31 Aug. 1979.

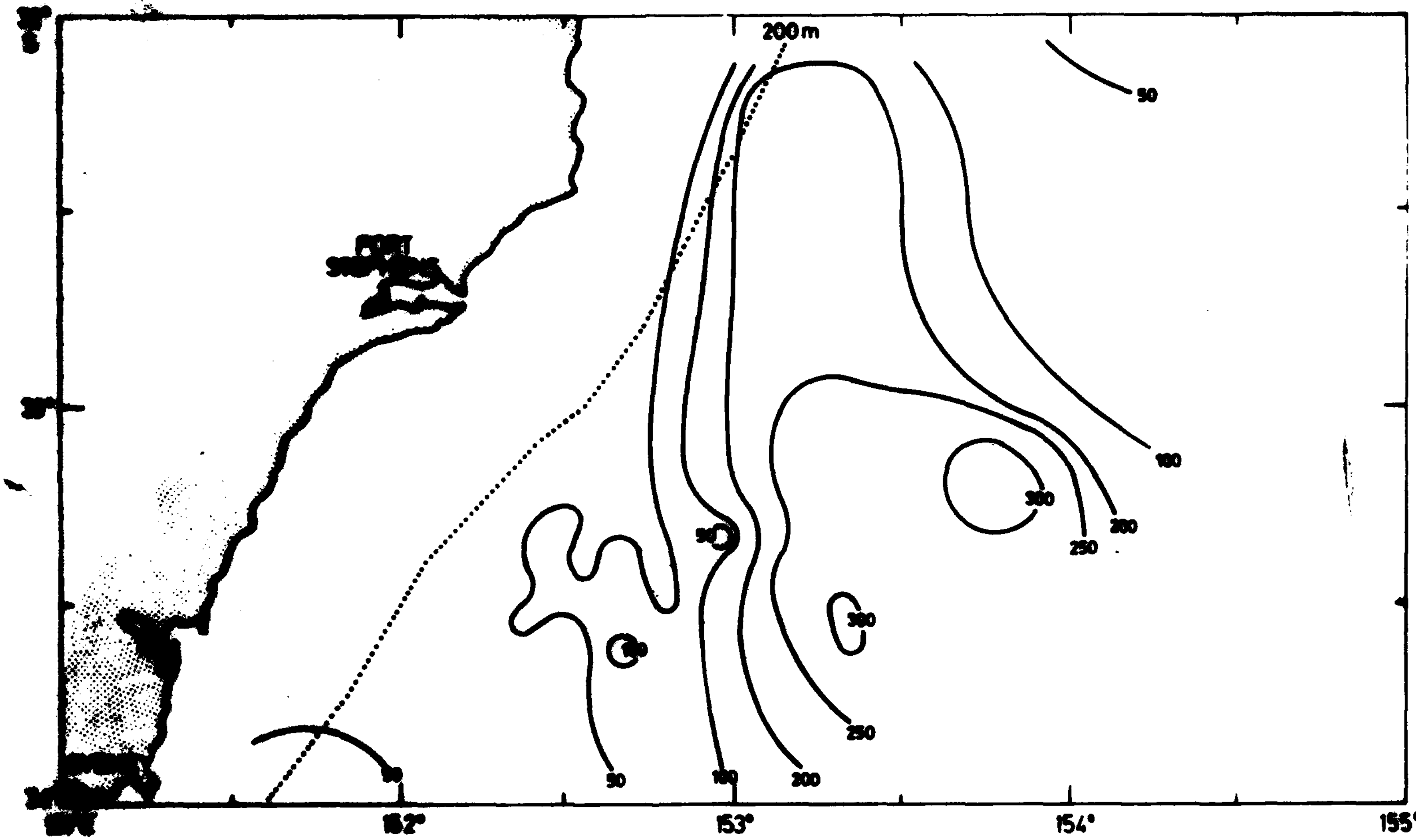


Fig.83. Depth of the mixed layer (m). SP9/79 17-31 Aug.1979.

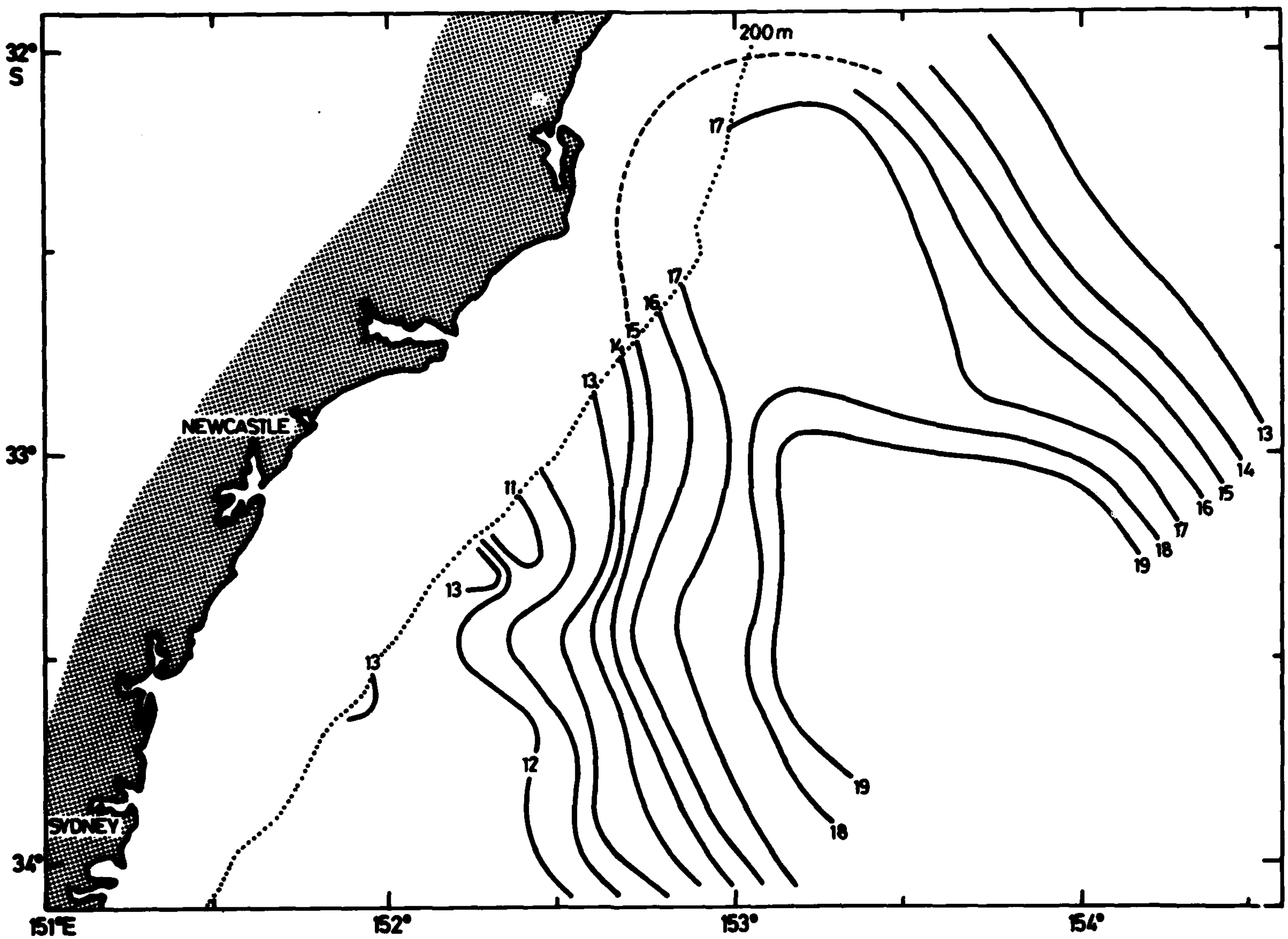


Fig. 84. Location of eddy "J" during SP 9/79 as indicated by the isotherm topography at 250 m. The boundaries of the eddy approximate to the 15°C isotherm.

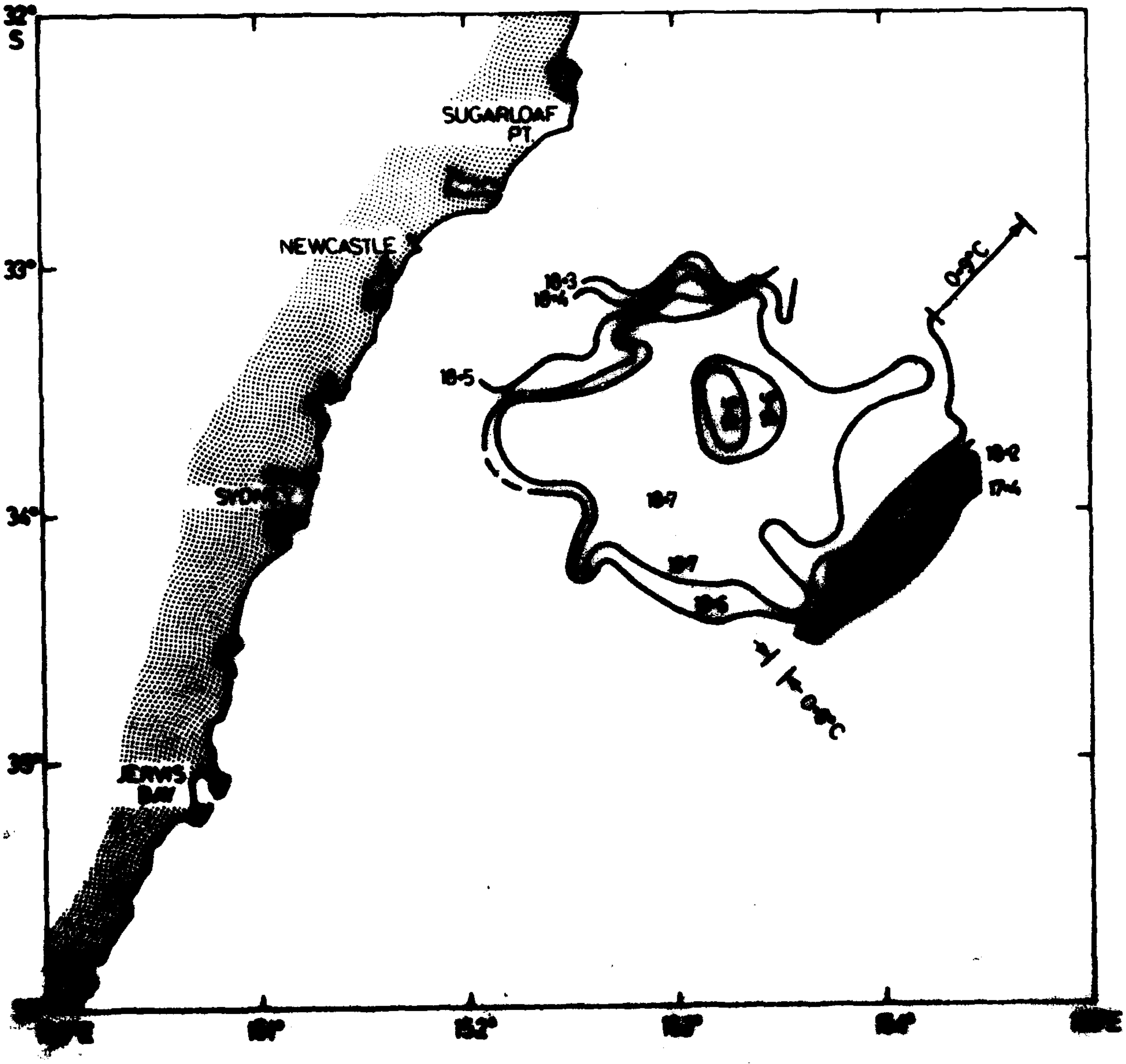


Fig.35. SST (°C). Cruise SP 10/78. 20 Sept. - 3 Oct. 1978.

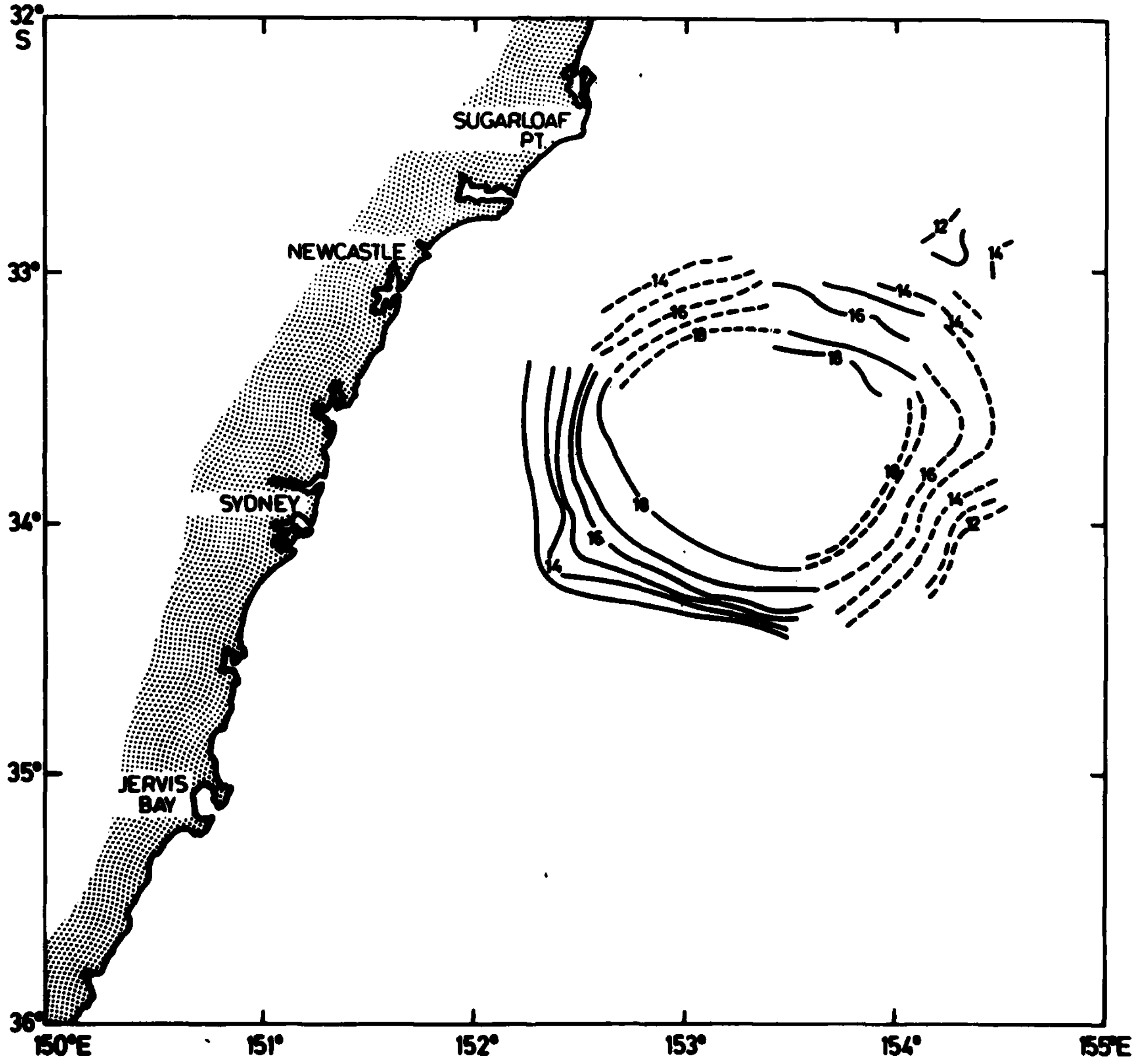


Fig.86. $T_{250}$ (°C). Cruise SP 10/79.

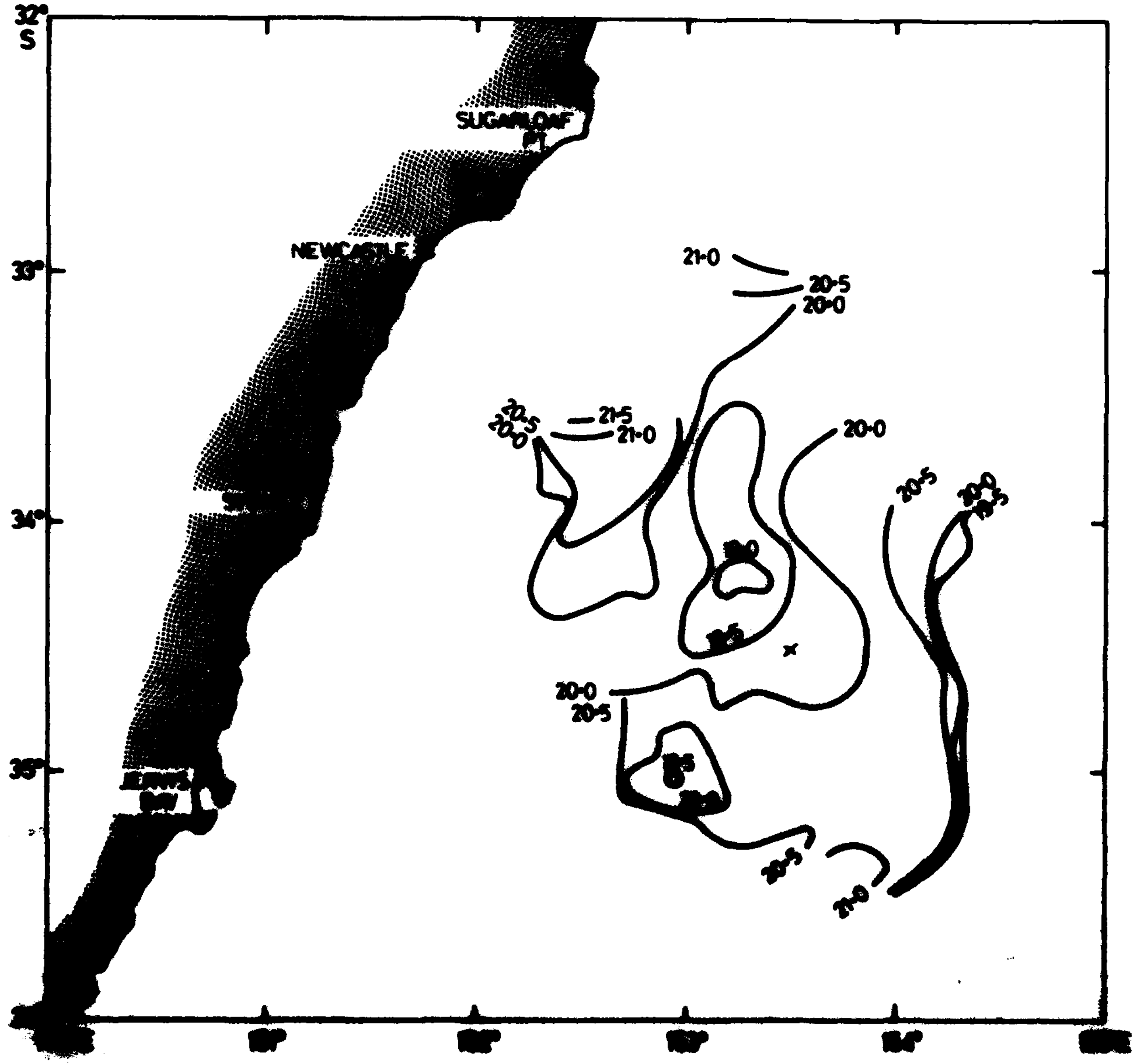


Fig.87 SST (°C). Cruise SP 11/79. 17–30 Oct. 1979.

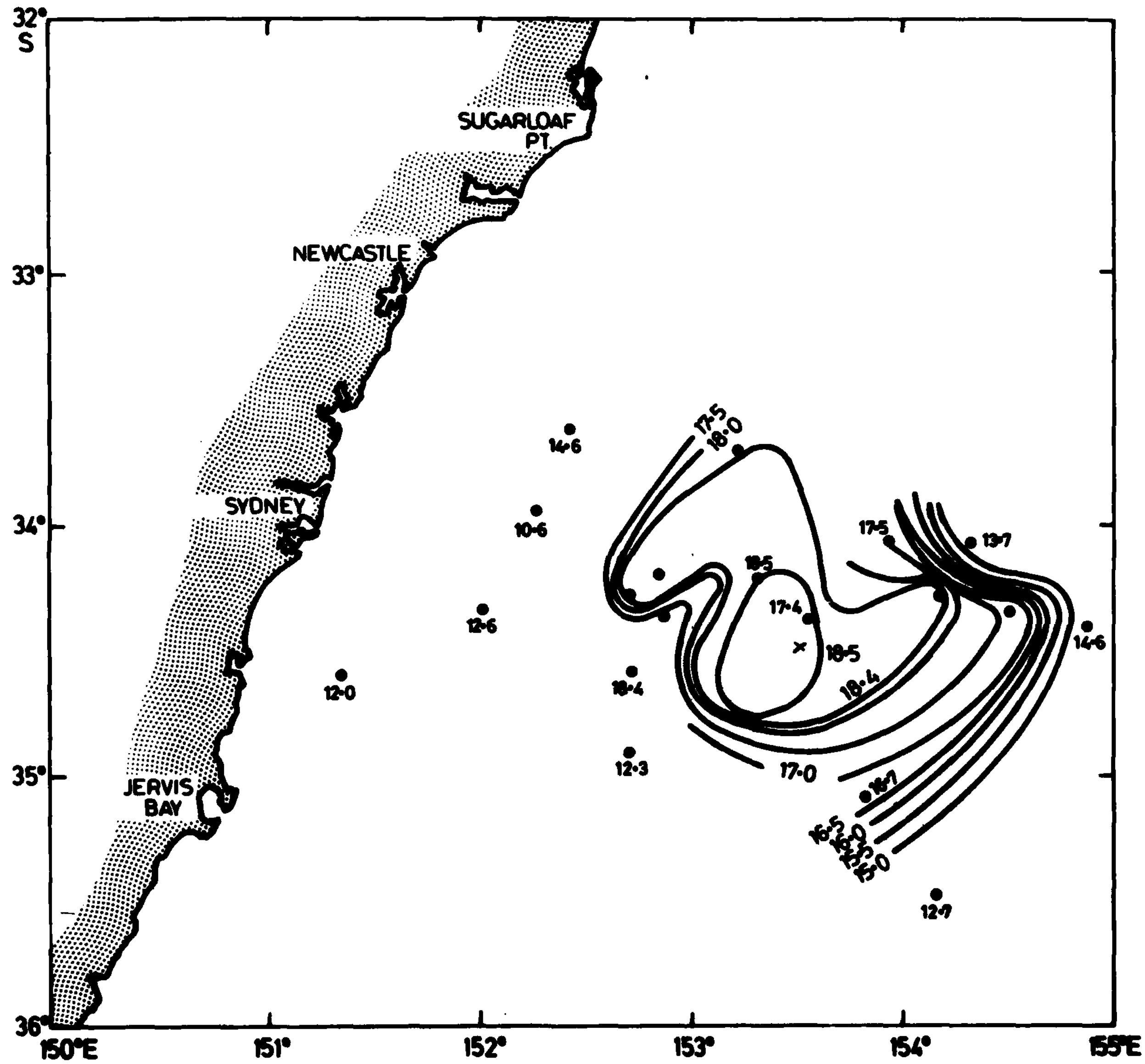


Fig.88. $T_{250}$ (°C). Cruise SP 11/79.

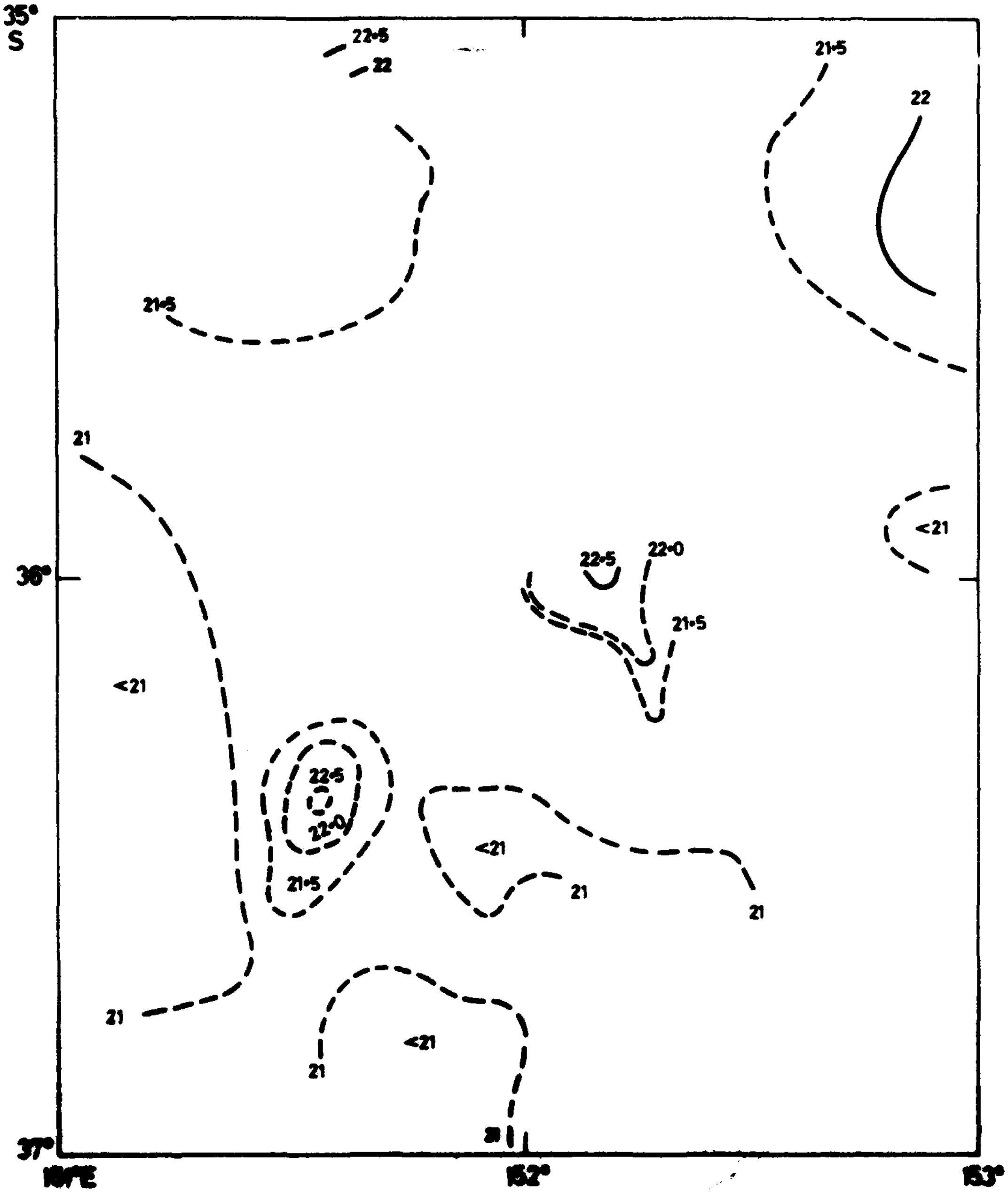


Fig.[illegible] SST(°C). Cruise SP3/80. 5–12 Feb. 1980.

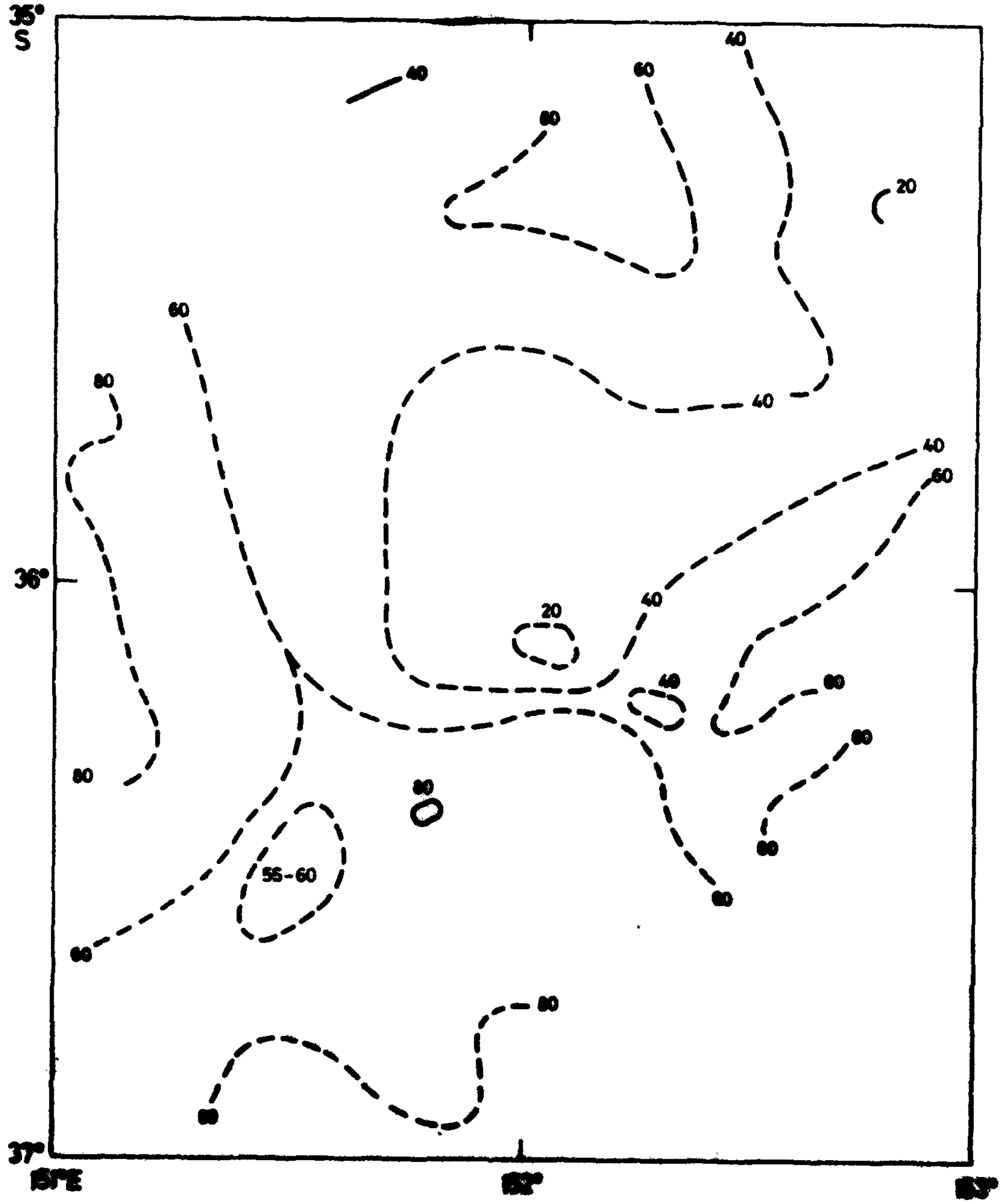


Fig. 90. M.L.D. Cruise SP3/80. 5-12 Feb. 1980

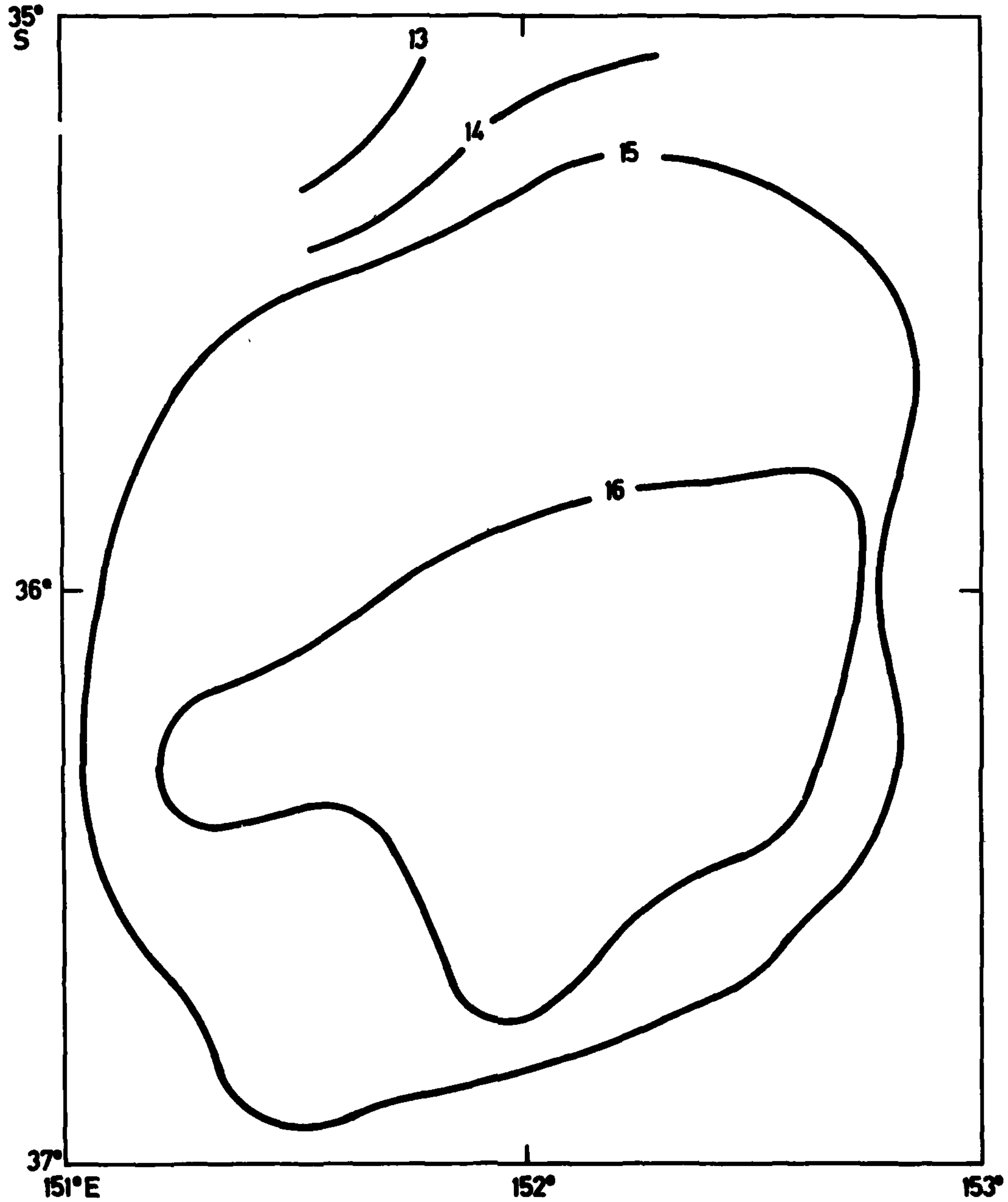


Fig.91. T250 (°C). Cruise Sp 3/80. 5-12 Feb. 1980.

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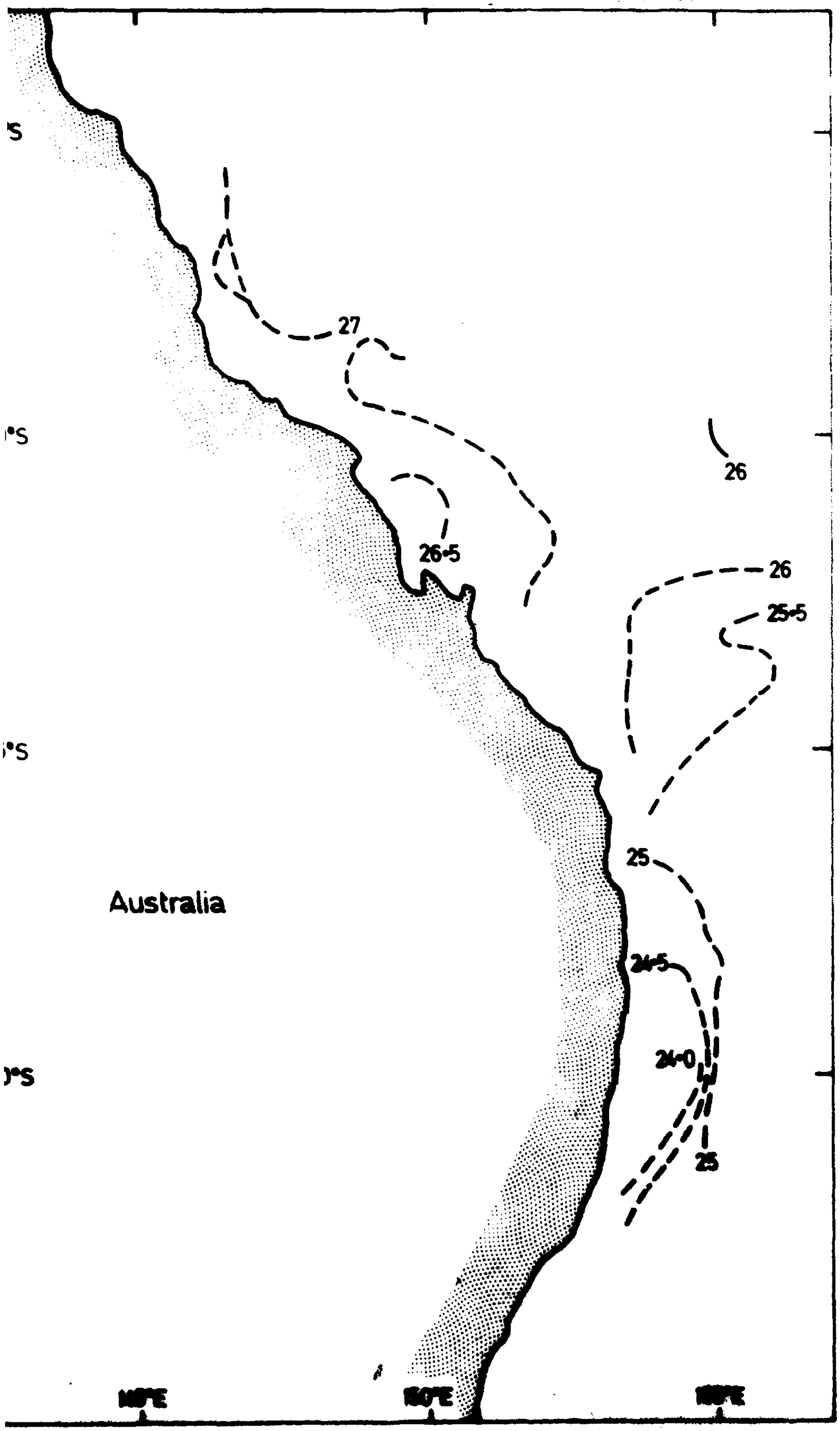
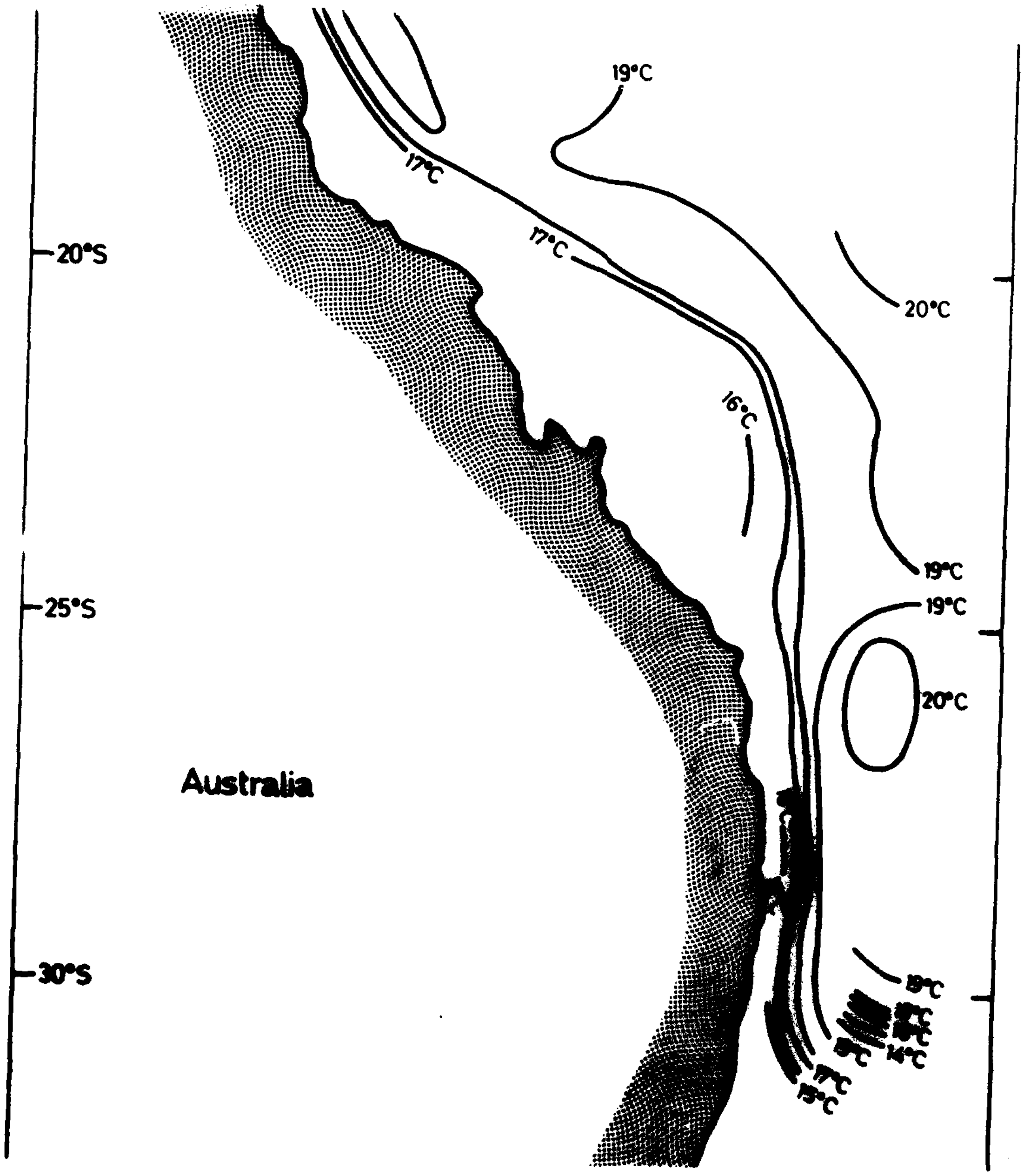



.82. [illegible] (FC). Cruise SP 6/80. 11–30 April [illegible].


19°C
17°C
17°C
20°S
20°C
16°C
19°C
19°C
25°S
20°C
Australia
30°S
14°C
17°C
15°C

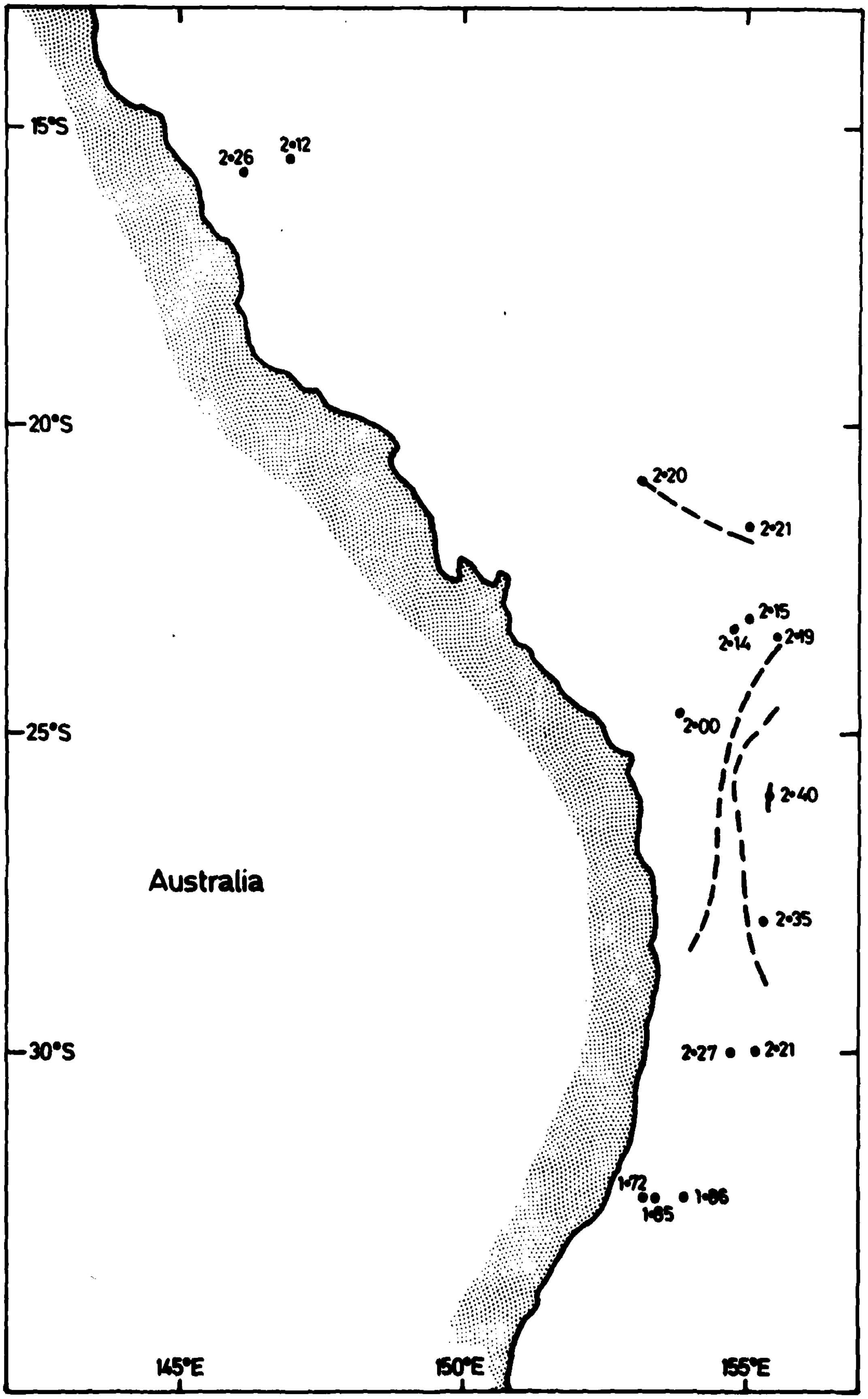



Fig.94. Dynamic Height relative to 1300m. Cruise SP 6/80.

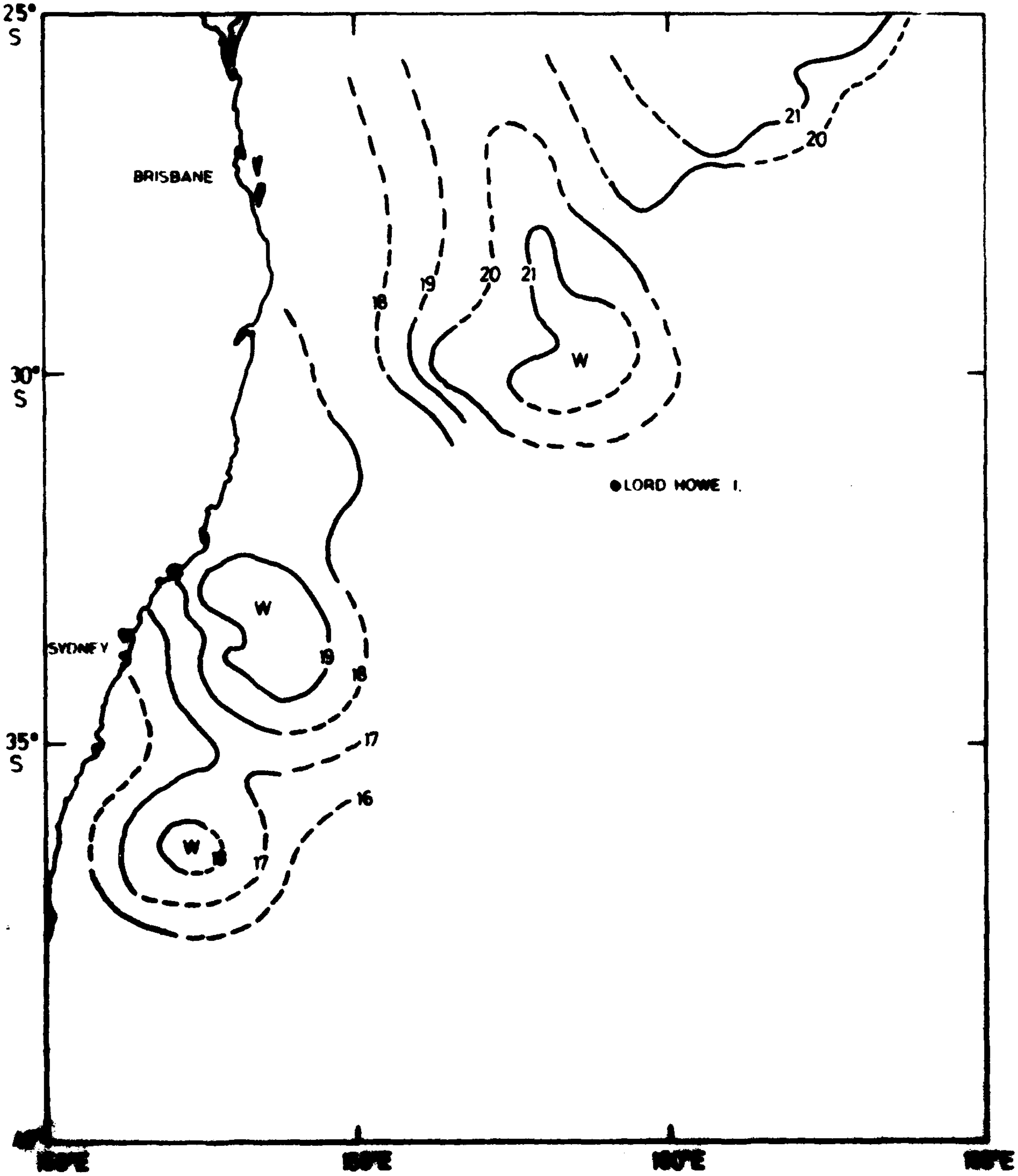



Fig.86. SST. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.

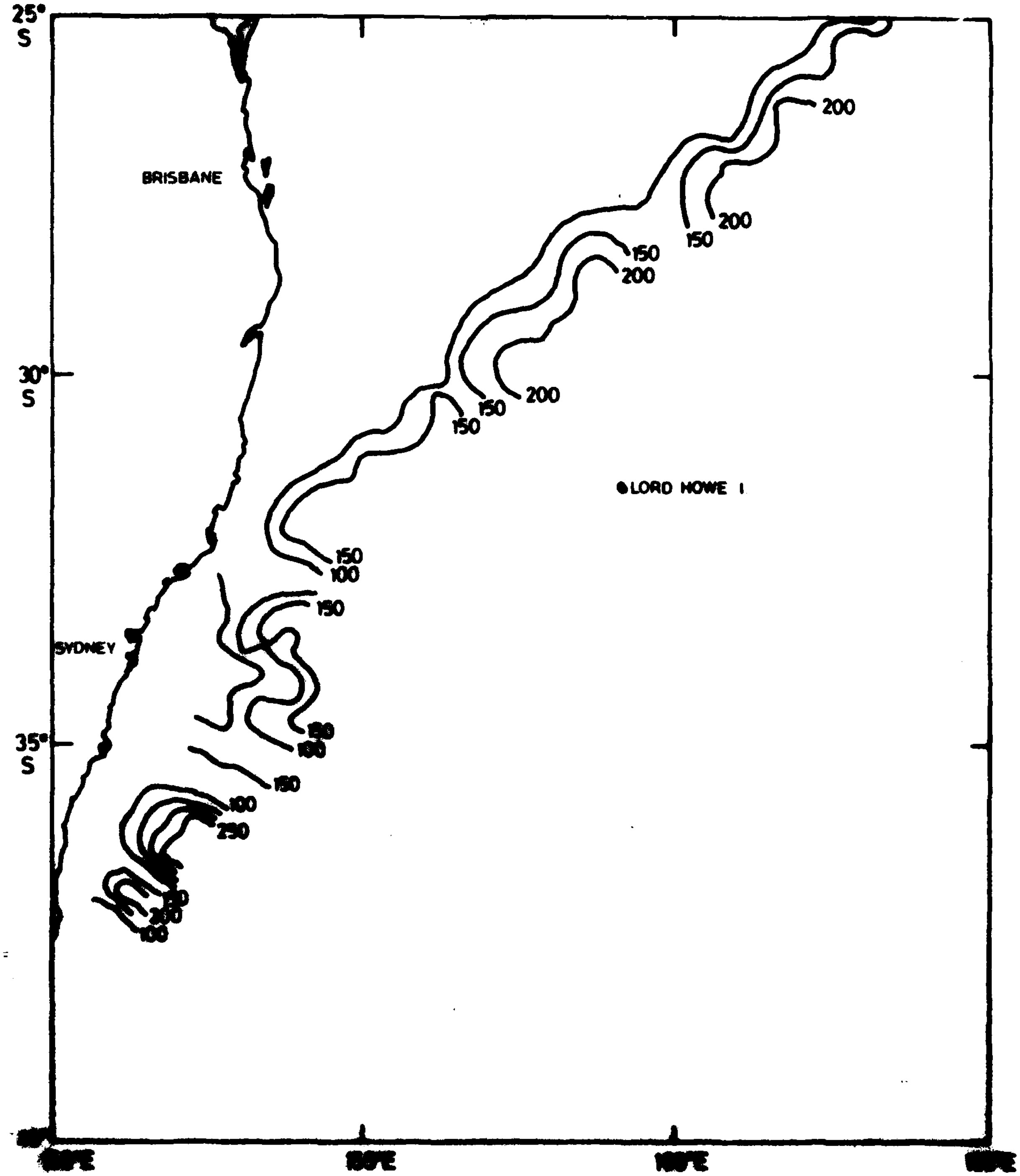



Fig.96. MLD. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.

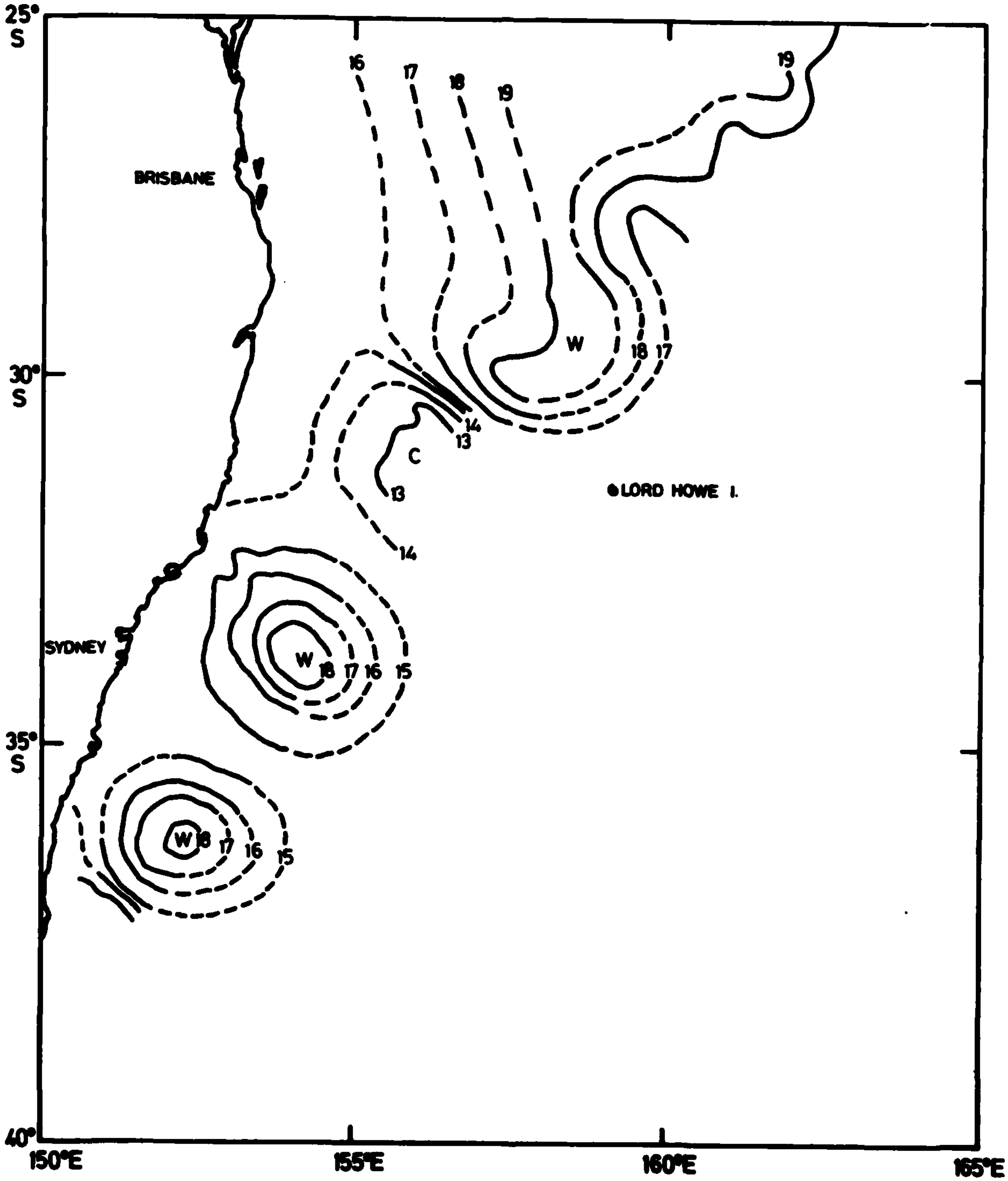
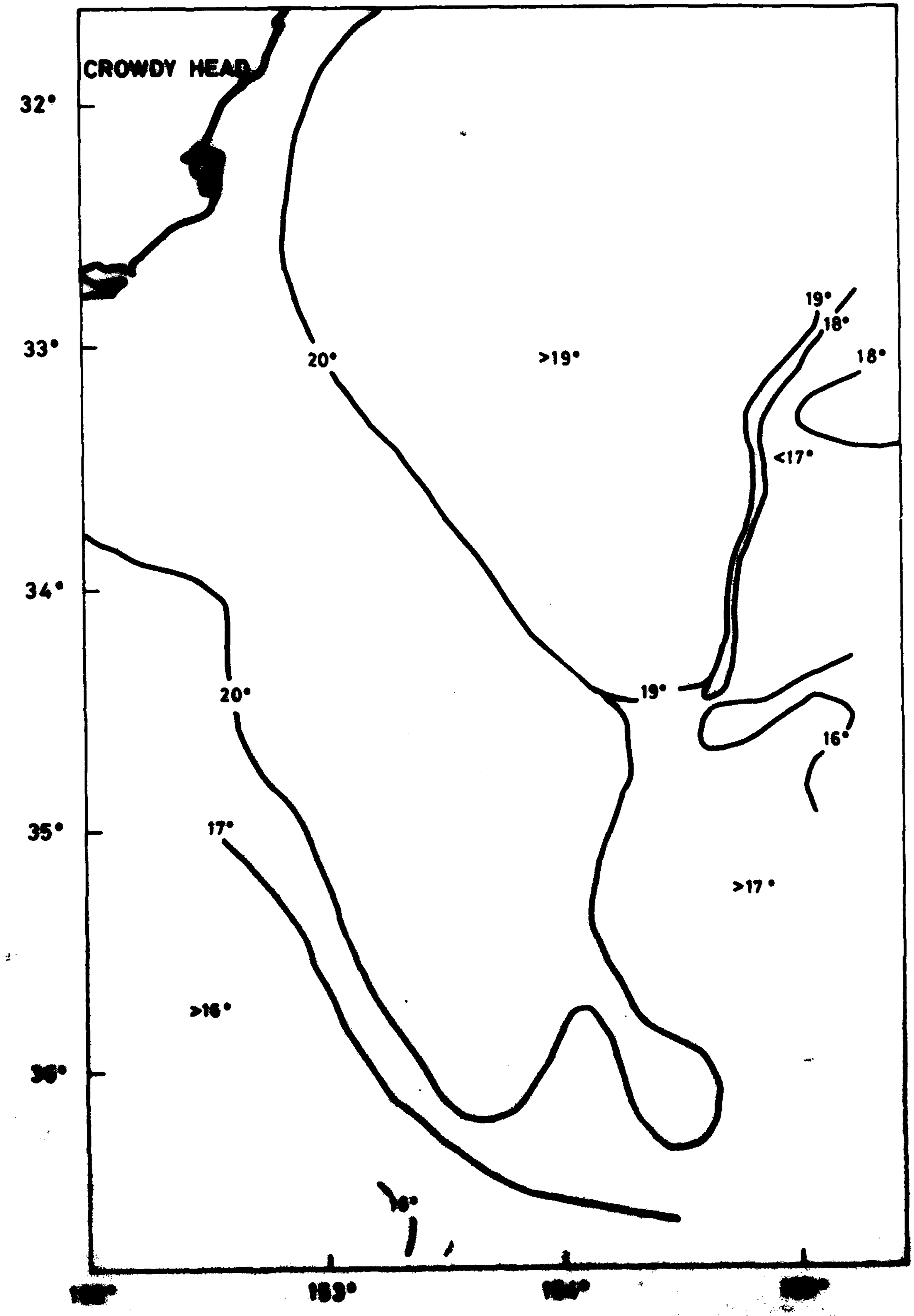



Fig.97. T250. Sprightly 3/80. 30-31 July. HMAS Yarra. 25-27 July.




[illegible]. SST [illegible]

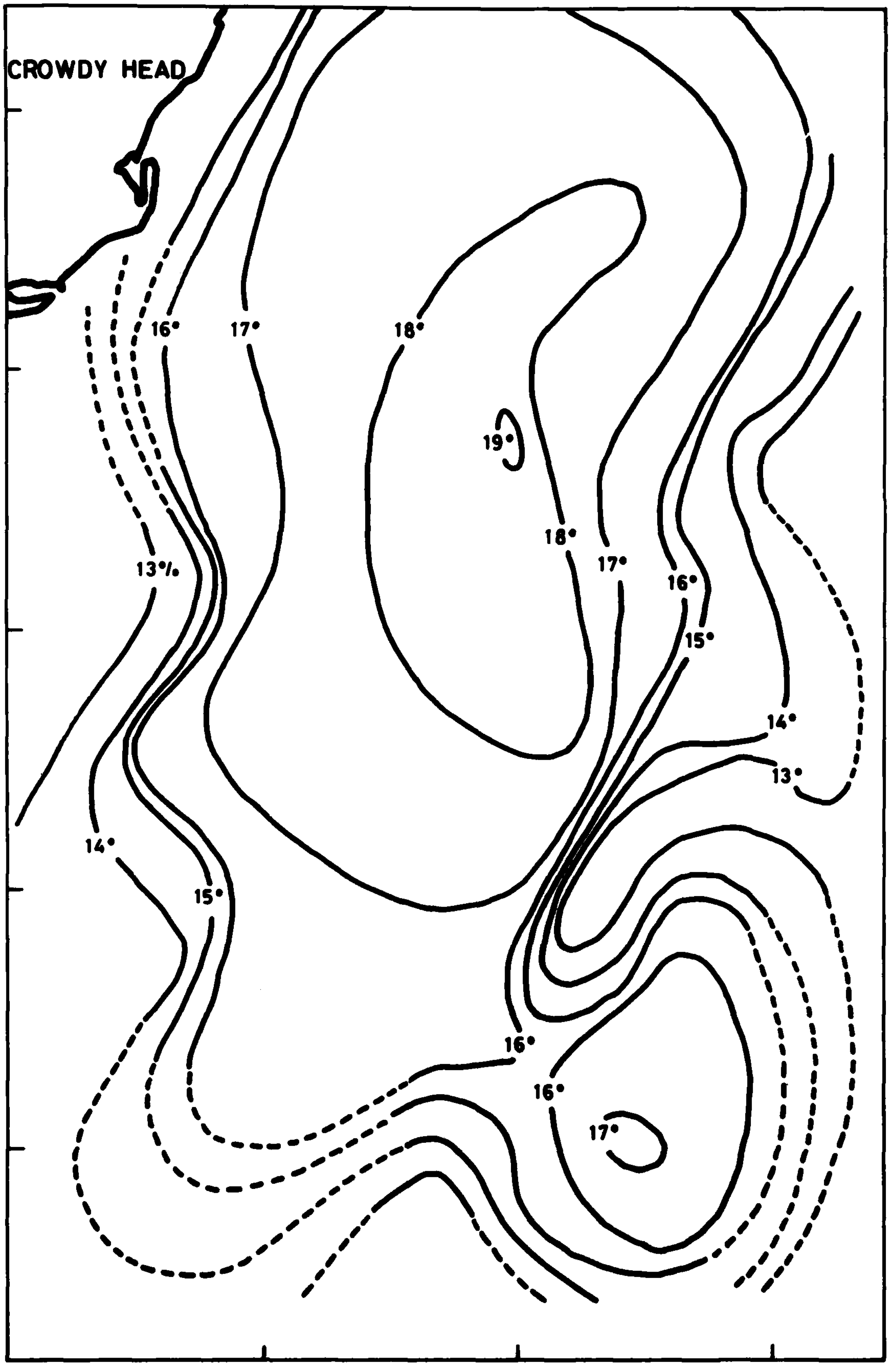



Fig. 99. T250 S04/81 SEP25 - OCT18 1981.

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16. Abstract

Comparisons are presented between patterns of sea-surface temperature, temperature at 250m, mixed-layer depth and dynamic height for the western Tasman Sea. Data are from ship cruises and aerial surveys. It is shown by comparing deep current structures, shown by the temperature fields at 250 metres and/or dynamic heights, with surface temperature patterns that on many occasions the latter revealed the East Australian Current flowing down the coastline, turning eastwards between 30° and 32° S and, sometimes, turning back to the north. Also on most occasions in winter and spring, and sometimes in summer-autumn, warm-core eddies were apparent in surface temperature patterns. In general, surface mixed-layers are deeper above anticyclonic features and shallower above cyclonic features.

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